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NUMBER 11-5-55

AIR DEFENSE OF THE SINO-SOVIET BLOC, 1955-1960

Submitted by the

DIRECTOR OF CENTRAL INTELLIGENCE

The following intelligence organizations participated in the preparation of this estimate: The Central Intelligence Agency and the intelligence organizations of the Departments of State, the Army, the Navy, the Air Force, and The Joint Staff.

Concurred in by the

INTELLIGENCE ADVISORY COMMITTEE

on 12 July 1955. Concurring were the Special Assistant, Intelligence, Department of State; the Assistant Chief of Staff, G-2, Department of the Army; the Director of Naval Intelligence; the Director of Intelligence, USAF; and the Deputy Director for Intelligence, The Joint Staff. The Atomic Energy Commission Representative to the IAC, and the Assistant to the Director, Federal Bureau of Investigation, abstained, the subject being outside of their jurisdiction.

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AIR DEFENSE OF THE SINO-SOVIET BLOC, 1955 – 1960

THE PROBLEM

To estimate the capabilities of Sino-Soviet Bloc air defense, and probable trends through 1960.

SCOPE

This estimate does not concern itself with the detailed strategy or tactics that might be employed by US air forces in an attack against the Sino-Soviet Bloc, nor does it attempt to evaluate the kill probabilities of the Bloc air defense weapons against attacking aircraft or missiles. It should also be recognized that many of the deficiencies of the Bloc air defense system are common to all air defense systems and should not necessarily be considered as weaknesses unique to the Bloc.

Section I represents the probable Soviet appraisal of the US air threat and Bloc requirements to meet it; Section II estimates the present strength and composition of the Sino-Soviet air defense system and Section III estimates the probable future trends of Bloc Air Defense including economic capabilities of the Bloc to support its air defense system. The estimate in Section III is based on the assumption that neither domestic or international political factors nor unexpected technological breakthroughs will alter the general nature of weapons programs as now envisaged in the Bloc and the West.

CONCLUSIONS

1. Air defense of the Sino-Soviet Bloc has been undertaken on a high priority. Developments to date have revealed two major areas of air defense concentrations. The most important is a huge area embracing all of European Russia and the European Satellites. In this area is concentrated about 70 percent of the Bloc fighter establishment with associated antiaircraft artillery and radar. The second major area is the Soviet Far East, in which is concentrated about 15 percent of Bloc fighter strength. Thus about 85 percent of Bloc air defense forces are concentrated in critical areas covering only approximately 2,000,000 square miles of the total Bloc area of 12,000,000 square miles. Outside of these main concentrations local defenses exist in a few chosen areas but large portions of the interior and certain border areas may have little or no active air defense. *(Paras. 36–37, 42, 50–51, 118, 120, Map III)*

2. The Sino-Soviet Bloc has large numbers of air defense forces and weapons of which the fighter aircraft units currently appear to be the most formidable. The Soviets have made great strides in radar development and have large quantities of both obsolescent and modern radar equipment. We estimate there are a total of about 900,000 men actively engaged in air defense in the Bloc and that the Bloc has an authorized fighter strength of some 14,600 including about 14,000 jets.[1] About 3,800 fighters are assigned to Fighter Aviation of Air Defense (IA–PVO); the remaining fighters assigned to other organizations also have some air defense responsibilities under a "multiple mission" concept. *(Paras. 46–51, 70–75, Map III)*

3. The USSR has an integrated passive air defense organization under the control of the MVD. A few cities have extensive underground installations. However, we believe the passive defense system does not greatly affect over-all Soviet air defense capabilities. *(Paras. 105–109)*

Present Over-all Capabilities

4. Against daylight bomber formations at altitudes between 5,000 and 35,000 feet in clear weather, we believe that Bloc fighters are now capable of inflicting severe losses against piston bombers and moderate losses against high-speed jet bombers. Above 35,000 feet altitude this capability would begin to diminish, and above 40,000 feet it would fall off markedly. Under circumstances of persistent visible contrails, these capabilities would, on the other hand, be markedly increased. Primary limitations would then be the numbers and individual capabilities of fighter interceptor aircraft available. *(Paras. 52–57, Appendix C)*

5. Although its all-weather air defense capabilities are increasing, the Bloc could offer only limited resistance under conditions of poor visibility. *(Paras. 51–57, 59–75, Appendix B)*

6. AA gun defenses are most strongly concentrated around Moscow and other areas of strategic importance. They can provide continuously aimed fire up to about 45,000 feet under both good and poor visibility conditions. However, presently deployed AA guns probably will not be capable of a high percentage of kills at these maximum altitudes or very low altitudes, even though controlled by modern fire control equipment. *(Paras. 59–63, 66–67, Appendix C, Map III)*

7. Although there is no conclusive evidence that surface-to-air guided missiles have been produced and deployed, we estimate that the USSR now has some surface-to-air guided missiles, probably concentrated in the Moscow area. These could considerably increase the kill probability against Allied bombers even in bad weather. *(Paras. 68–69)*

8. Against multiple-pronged penetrations utilizing altitude stacking, diversionary tactics, and electronics countermeasures, we believe the Soviet air defense system is susceptible to serious failures. *(Paras. 21–23, 27–35, 52–104)*

9. Against forces penetrating peripheral defended areas at high speed and minimum altitude the effectiveness of the defense would be very low. *(Paras. 34, 52–104, 110–111)*

[1] Actual strength is estimated to be approximately 85 percent of authorized (TO&E) strength but varies considerably as new aircraft are phased in.

10. *Future Over-all Capabilities.*[2] The objectives of Bloc air defense planners are almost centainly to: (a) develop and produce in quantity equipment capable of combating the Western air attacks; (b) rapidly improve the training of air defense units; (c) develop better communications facilities; (d) improve the airfield network; and (e) improve the air defense organization. In meeting these objectives, the Sino-Soviet Bloc will probably emphasize the development of guided missiles, supersonic all-weather fighters, and improved radar equipment. *(Paras. 110–111)*

11. In accordance with these objectives, we believe that Bloc air defenses will be substantially strengthened during the period of this estimate. Considerable numbers of fighters of new types will be introduced into operational units, replacing older types; there will be a particularly significant increase in the proportion of all-weather fighters. Improved radar equipment will be available, and early warning and GCI systems will be extended into areas which are at present wholly or partially uncovered. New and improved antiaircraft artillery will come into use. Guided missiles with nuclear warheads will probably be developed by 1958, and will become increasingly important in air defense. These developments, and particularly the latter, will greatly increase the kill probability against Allied air attacks and will magnify the problems of such attacks. *(Paras. 112–125)*

[2] The estimates in Paragraphs 10–13 are based on the assumption that neither domestic and international political factors nor unexpected technological breakthroughs will alter the general nature of weapons programs as now envisaged in the Bloc and the West. See also SCOPE note above.

12. Despite these improvements, we estimate that Bloc air defenses would fall considerably short of providing air defense of the scale and nature required by the probable Western air capabilities. *(Paras. 21–35, 112–125)*

13. The estimated Bloc air defense program through 1960 would constitute a substantial but not impossible burden on the Bloc economy. We believe the cost would be such as to require either a diversion of resource from other military uses or an increase in total military budget such as would probably lead to some reduction in the rate of growth of the economy. Fulfillment of the electronics requirements of the program would be particularly difficult. *(Paras. 126–133, Appendix D)*

Defense Capabilities by Region

14. The estimates of regional capabilities are based upon available evidence at this time. In those areas where there is almost a complete lack of evidence on air defense, we have assumed that air defenses are weak. However, it is possible that air defense forces and installations do exist in these areas.

15. *European Satellites.* Air defense of the European Satellites (except East Germany) insofar as it depends upon Satellite forces is estimated to be generally inferior to that of critical regions within the USSR. The Satellite air defense forces are generally poorly trained and equipped with obsolescent aircraft and equipment and they would be incapable of meeting air defense requirements or of preventing transit of Western bomber forces enroute to the USSR. Under daylight conditions at altitudes between 5,000

and 35,000 feet, they could inflict considerable damage on attacking bomber forces unescorted by fighters. These capabilities would be increased to the extent that Soviet air defense forces were deployed to these areas.

16. *Soviet Far East.* The concentration of radar, antiaircraft artillery, and fighters in the Soviet Far East make it one of the best defended areas of the USSR. The Kamchatka and the Chukotski regions are less well defended than the Maritime Provinces of the Far East but do have reasonably adequate early warning radar. Because of the operational difficulties and the limited fighter and AAA forces available in these areas, only limited resistance could be provided. We believe the air defenses of these areas will be considerably strengthened between now and 1960 but will still be below that of the Maritime Provinces.

17. *Kola and Leningrad Areas.* These areas are considered to be relatively well defended in terms of forces and equipment. Radar coverage extends eastward from Kola to approximately 50° East longitude, but the density of radar in the eastern part of this area is probably not as great as in other critical approach areas. We believe it will be considerably strengthened during the period of this estimate.

18. *Baltic-Central and Western USSR-Black Sea.* These are the most heavily defended regions of the USSR. The major portion of Fighter Aviation of Air Defense, large concentrations of AAA including possible guided missile sites, all of the fighters of the Baltic and Black Sea fleets, and the bulk of the Soviet tactical air forces are located in this area. It is estimated that continuous tracking of hostile aircraft can be accomplished throughout this area since the concentration of radar sites is greater than our assessment of actual requirements.

19. *China – North Korea – North Vietnam.* Substantial air defense capabilities exist in North Korea, Manchuria, and North China. Along the extreme southern coastal areas the air defense capabilities are less and in the interior areas are virtually nonexistent. Early warning capabilities are being extended southward along the coast. Air defenses are generally being expanded in the Shanghai-Canton-Changsha area. The size of the entire region makes the development of an air defense network a task of great difficulty and expense. Consequently we believe that the air defense to be provided the region during the period of this estimate will remain considerably inferior to that attained by the USSR itself.

20. *Other Areas.* As far as is known, there are virtually no air defense forces available along the northern Siberian coastline and very few forces or radar sites in central Siberia. We estimate that practically no air defense capabilities exist in this area except around local critical target areas along the Trans-Siberian railway. In like manner, the southern borders of the Bloc in Central Asia also appear to be practically undefended. We estimate that early warning radar lines will be established along these borders by 1960 and that all air defense forces will be increased. However, we do not believe the USSR will be able to provide a strong air defense system in these areas by 1960 due to the size of the areas and the many problems related to operations and logistics.

DISCUSSION

I. THE MAGNITUDE OF SINO-SOVIET BLOC AIR DEFENSE REQUIREMENTS

Soviet Estimate of the Air Threat to the Bloc*

21. The intensive buildup of Bloc, and particularly Soviet, air defenses since World War II indicates that the USSR is acutely aware of the threat posed to the USSR by Western nuclear air power. The Soviet planners recognize that the Bloc is geographically surrounded by US and Allied air power to such an extent that from present or programmed overseas bases, the major portion of the Bloc can be reached by US medium bombers on two-way unrefueled missions (See Map 1) and that US heavy bombers, or refueled medium bombers, can reach anywhere in the Sino-Soviet Bloc either from overseas or from ZI bases. They also probably estimate that a large portion of the Bloc can be attacked by refueled fighter bombers, light bombers, and by carrier aircraft, and that US air strikes could penetrate the Bloc at any point.

22. *Warning Times.* Due to the fact that the Bloc is almost surrounded by US bases and the fact that US carriers can operate in waters adjacent to Bloc boundaries, the problem of achieving adequate warning must appear extremely difficult to the Soviet planners. This problem will become more difficult during the period of this estimate, since the speed of US aircraft is increasing at a more rapid rate than the increase in range of early warning radar (See Map 2). Thus, although a minimum of two hours' warning can be achieved by the Bloc for a considerable portion of their land area in 1955, by 1960 they would not be able to achieve a maximum of two hours' warning of attack by aircraft even for the central area of their territory unless their early warning zone were extended beyond their frontiers at least 750 nautical miles.

23. *Aircraft.* The USSR probably estimates that during this period the Bloc could be attacked by Western jet and piston aircraft with radii of action up to 4,000 nautical miles, speeds up to 1,150 knots, and operational altitudes up to 64,000 feet. Based upon their own experience and upon knowledge of US organizational goals, production capabilities, budgetary considerations, and aircraft development, the Soviets could probably make a fairly accurate estimate of the numbers of US aircraft which would be available for strikes against the Bloc. We believe that this estimate might be approximately as follows:

Aircraft	1955*	1957	1960
Heavy Piston Bombers	300	200	....
Heavy Jet Bombers	a few	200	600
Medium Piston Bombers	100	....	....
Medium Jet Bombers	1,000	1,200	1,000
Light Jet Bombers	100	350	350
Jet Fighter Bombers	2,050	2,900	3,000
Navy Patrol Bombers	120	120	100
Carrier-Based Aircraft	800	800	800
TOTAL	4,470	5,770	5,850

(See Appendix A for probable Soviet estimate of performance characteristics of aircraft and missiles and dates of availability for operational use.)

24. *Guided Missiles.* The Soviets probably could not estimate with any accuracy the numbers of guided missiles which could be employed against them during the period of this estimate; however, they could probably arrive at a fairly good estimate of missile availability in terms of total production and, in some cases, order of battle. On this basis, they probably estimate that US and Allied stockpiles would include by 1960 a few long-range missiles and several thousand of the smaller types. They would probably estimate that the following general categories of guided missiles might be available for use against them:

*This Soviet estimate of the US air threat is based upon information available to the USSR in open sources such as newspapers, magazines, and officials releases.

Type	Miles Range	Altitude (ft.)	Mach Speed	Warhead Weight
Short-Range SSGM	500–800	45,000	m0.9	3,000
Medium-Range SSGM	1,200	60,000	m2.4	3,000
Long-Range SSGM	3,000	80,000	m3–4	1,200
Long-Range SSGM	5,000	50,000	m.8–.9	6,000
Long-Range SSGM	5,500	85,000	m3–4	7,000
Long-Range (Ballistic)	5,500	200nm	m10-20	3,000
Air-to-Surface GM	100	60,000	m2.5–3	5,000
Air-to-Underwater GM	20	....	m0.5	500

They also probably estimate that some of these missiles could be launched from naval vessels and that several carriers, cruisers, and submarines will be equipped for such launchings.

25. *Aircraft Armament and Electronics.* The Soviets probably estimate that US bombers will have: (a) improved radar-sighted machine guns with automatic fire control; (b) air-to-air rockets; (c) air-to-air guided missiles; (d) airborne radar detection and jamming equipment; (e) a self-contained navigational system to operate over all types of terrain and under all weather conditions; (f) improved bombing-navigational radar; and (g) defensive radar for detection and fire control.

26. *Bombs and Warheads.* The Soviets probably estimate that all strike aircraft could carry either nuclear or conventional weapons; however, delivery tactics, dictated to some extent by the characteristics of a specific aircraft type, would fix the limits of the yields of nuclear weapons which could be utilized. Dive or toss-bombing could be employed for the smallest-yield weapons, loft-bombing for medium-yields, and high altitude horizontal bombing for high-yield weapons.

27. *Scale and Direction of Attacks.* The Soviets probably estimate that the US possesses great flexibility in methods and direction of attack. They probably estimate that the scale and direction of attacks might include: (a) simultaneous attacks from all directions by several hundred aircraft; (b) sustained attacks over a period of several hours from one direction only; and (c) widely separated sustained attacks by individual aircraft from all directions and at all altitudes up to 64,000 feet. They probably would anticipate attacks against the Bloc by medium bombers from bases in the US, UK, France, Italy, Greece, Spain, Turkey, North Africa, the Philippines, Okinawa, Japan, and Alaska. Land-based fighter-bomber aircraft could be launched from bases in some of these areas and from bases in other forward areas, such as South Korea, Formosa, and West Germany. (See Map 1). Attacks could also be made by heavy bombers and refueled medium bombers from bases in the US and Canada, and from such forward base areas as Guam, Greenland, and the Azores.

28. The Soviets might expect air attacks launched from carrier task forces operating in the Barents Sea, the Norwegian Sea, the Mediterranean, and in the western Pacific. They probably calculate that carrier task forces could operate 300-400 miles from their coast lines in these areas which would allow penetration by carrier aircraft to distances up to 800 nautical miles.

29. The Soviets probably expect guided missiles to be launched against Bloc targets. Medium-range missiles could be launched from overseas bases and naval vessels; short-range missiles from forward US overseas bases, surface ships, submarines, and aircraft; and possibly long-range (intercontinental) guided missiles from bases in the continental US and Canada.

Probable Air Defense Requirements to Meet Estimated Threat

30. *Introduction.* The requirements for an effective Bloc air defense system have been considered in the light of: (a) the probable Soviet appraisal of Western capabilities for attacking the Bloc; (b) evidence of the type of air defense system already developed by the USSR; (c) US air defense experience and concepts; and (d) the estimated characteristics of such Bloc air defense equipment as radar, aircraft, and AAA weapons. Many of the problems inherent in the efficient functioning of an air defense system have not been evaluated in arriving at these requirements. However, we believe the air defense requirements

stated herein constitute the most probable objectives of Soviet air defense planners through the period of this estimate. Any great increase over the requirements stated might be considered too costly and any large decrease would probably be considered too risky by Soviet authorities. Although it is possible that the Soviets might plan an air defense system entirely different from the one envisioned in these requirements, present Soviet air defense trends indicate that the chances favoring this would be slight.

31. *Detection.* During the period of this estimate we believe the Soviet Bloc will have a requirement for an early warning system which will allow detection of all types of aircraft and nonballistic guided missiles at altitudes up to 85,000 feet. In terms of the probable speeds of attacking aircraft and a desirable warning time of 30 minutes, the distances at which early warning is required from Bloc frontiers will vary from 300 nautical miles for present aircraft to 750 nautical miles for aircraft and missiles by 1960. To meet these requirements, the Soviets would have to (a) extend their early warning installations beyond their present boundaries in certain areas by the use of early warning aircraft and picket ships, and (b) generally extend their present capabilities by use of improved radar equipment and a greater number of sites. A theoretical minimum of some 600 early warning radar sites would be required to provide two rings around the Bloc.

32. *Tracking, Reporting, and Command Reaction.* In order to provide a coordinated picture of the air situation in the responsible control centers and to provide continuous detailed information on specific targets, radar coverage would be required in depth to the major target areas. In addition, an automatic data processing and control system would be required to meet the demands for more rapid evaluation and transmission of data. This requirement would necessitate at least 350 GCI radar sites in the Soviet Bloc, together with greatly improved communications facilities in general, including a total of some 200,000 miles of landlines or other secure communications channels and an automatic data handling system. To permit efficient command reaction at all levels, a highly centralized air defense organization permitting prompt general direction of all passive and active air defense units would be required. However, the critical nature of the time element in air defense requires that many of the operational decisions heretofore made by major commanders must be relinquished to lower command echelons. This would be highly dependent upon individual responsibility and initiative and would necessitate a high level of individual and unit training for all air defense organizations.

33. *Identification.* The Soviets will have a requirement for an IFF system which will provide identification of friendly aircraft under all conditions. Such a requirement would necessitate some 21,000 IFF sets for equipment of operational aircraft.

34. *Engagement and Kill.* In view of present trends in Soviet air defenses, the Soviets almost certainly estimate that they could not rely upon one weapons system alone, and that several would be required for an acceptable capability for interception and kill under night and all weather conditions. To meet these needs, they will have to greatly improve the performance characteristics of their interceptor aircraft and AAA weapons. Defensive missiles will almost certainly be required for use against enemy supersonic aircraft and missiles. Defense against low altitude attacks will require missiles (guided and unguided) in large numbers in addition to improved automatic weapons. The Soviets would probably estimate the following as Bloc operational weapons requirements for air defense of the Bloc during the period of this estimate:

AW Fighters	10,000
Day Fighters	5,000
Light AAA Weapons	17,000
Heavy Antiaircraft Guns	13,000
Short-Range SAGM	30,000
Air-to-Air Guided Missiles	120,000
Rockets or Missiles (for low altitudes)	500,000 to 1,000,000

35. *Air Facilities.* There are now about 1,200 airfields in the Bloc suitable for fighter opera-

tions. However, the Soviets probably consider many of these fields unsuitable to meet air defense requirements through the period of this estimate. They probably estimate that many have to be improved and that new fields have to be constructed in peripheral areas and in highly important defense regions. They might require a total of some 2,000 airfields by 1960, of which about 1,500 would be needed for air defense and 500 for other operational requirements.

II. PRESENT BLOC AIR DEFENSES

36. Soviet appreciation of the growing Western air and nuclear capabilities is reflected in the intensive postwar buildup of Soviet air defenses, and the high priority and great resources allocated to this effort. Postwar Soviet air defense doctrine was greatly influenced by the USSR's evaluation of US/UK wartime strategic bombing, Western and German scientific developments such as radar, jet aircraft and guided missiles, and the air defense systems developed by the Germans and the Western Powers. Since the war the USSR has seen the vast growth in the US nuclear and delivery capabilities. From its evaluation of these developments has emerged new air defense concepts geared to the facts that the US and its NATO allies are the chief potential enemies of the USSR, and that the most immediate critical threat they pose to the USSR lies in their extensive capabilities for nuclear air attack.

37. To meet the postwar air defense requirements of the USSR, the Soviet planners embarked upon an intensive re-equipment and reorganization program. Jet interceptors and ground radar equipment were the first major new items to appear in quantity. At the same time, the Soviets recognized the need for improved antiaircraft fire control equipment, air defense guided missiles, an improved system for employment and control of air defense forces, and an airfield network suitable for use in air defense.

38. Soviet doctrine is now clearly showing the impact of nuclear warfare considerations. This problem has been under intensive study at Soviet High Command level and in Soviet staff academies since 1945. Only recently, however, have the Soviets begun to disseminate to the armed forces and the civil population instructions for dealing with nuclear warfare. This action became discernible during the latter half of 1953 and has been more prominent during 1954 and early 1955. Nuclear warfare considerations are now a conspicuous part of Soviet military doctrine.

Over-all Organization of Air Defense

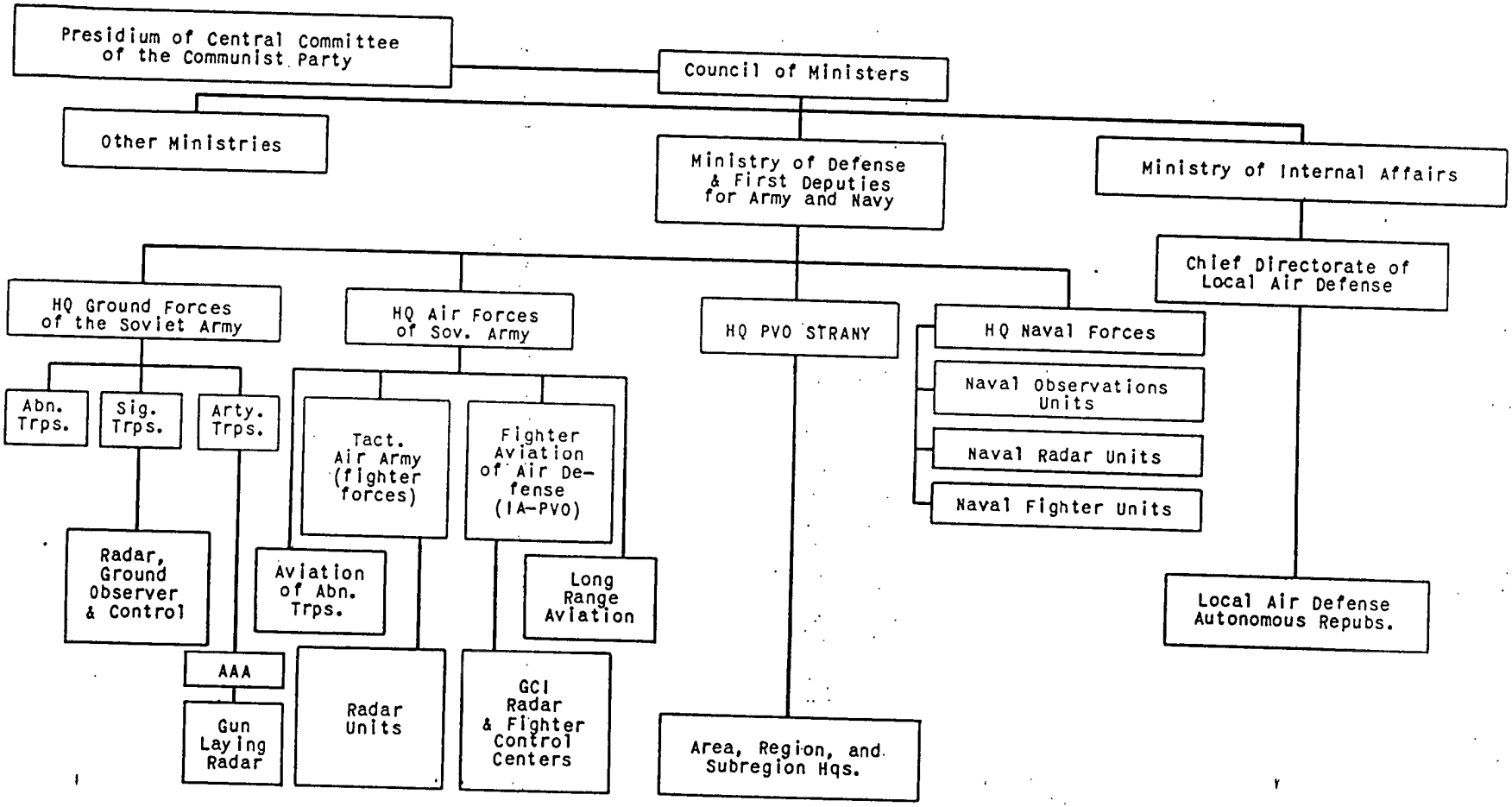
39. The organization of Soviet air defense remained essentially the responsibility of local commanders until 1949, when a more centralized system of air defense was instituted with appropriate headquarters and geographic subdivisions. The Ministry of Defense is responsible for active air defense measures while passive air defense programming is handled at the ministerial level by the Chief Directorate of Local Air Defense which is subordinate to the Ministry of Internal Affairs (MVD).

40. *PVO STRANY.* The agency within the Ministry of Defense primarily responsible for active air defense is PVO STRANY, literally "Antiair Defense of the Country." PVO STRANY appears to be a major operational headquarters co-equal in status with the two other ministry-level commands: Long-Range Aviation and Airborne Forces. Its commander-in-chief is probably a Deputy Minister of Defense for Air Defense and directly subordinate to the Minister of Defense. Through the various air defense regional commanders he has operational control over fighter aircraft, AA artillery, and communications and warning units assigned or made available to PVO STRANY. However, these units remain administratively subordinate to their respective ground, air, or naval services as shown in Chart I. For example, the fighter units of PVO STRANY are administratively subordinate to the headquarters called Fighter Aviation of Air Defense (IA-PVO), which is in turn administratively subordinate to headquarters of the Air Forces of the Soviet Army.

41. Responsibility for air defense has consistently remained under ground force officers, and the CINC of PVO STRANY has traditionally been an artilleryman. The air forces,

CHART I

SOVIET ADMINISTRATIVE AIR DEFENSE CHANNELS



as a whole, have not achieved independent status in the USSR as they have in many Western nations and the IA-PVO has remained under the command of ground force commanders at most operational levels. IA-PVO is traditionally commanded by an air officer but it is believed that operational command flows directly from the CINC PVO STRANY to the Commanders of Air Defense Regions rather than through the IA-PVO commander.

42. The forces of PVO STRANY are probably unified at the regional defense level under regional air defense commanders. We believe that the air defense regions correspond generally with the major industrial and military areas of the USSR. The commander of a region probably controls all units of control and warning, IA-PVO, and antiaircraft artillery forces assigned to PVO STRANY as well as other elements of the Army and Navy having air defense functions in his region. In addition, he probably coordinates the air defense activities of the passive defense units, the border guards of the MVD, and the ground observer units. He appears to be directly responsible to a major control headquarters for coordination and control of all air defense activities in his region. There are probably two such headquarters: one in Khabarovsk and one in Moscow. Lower organizational levels of PVO STRANY have probably been unified below the regional air defense level into subregional organizations. Operational channels of responsibility are believed to be as indicated in Chart II.

43. The Soviet Navy is responsible for the defense, including air defense, of the sea approaches, the coasts, and major ports and naval bases of the USSR. The PVO organization of the Navy, operating within the various fleets which exercise regional control, receives top level direction from PVO STRANY. There are also PVO departments in the headquarters of the Air and Artillery Forces of the Soviet Army in Moscow which are believed to maintain coordination with PVO STRANY. PVO headquarters elements also exist at each Group of Forces and Military District headquarters and at subordinate levels for the purpose of coordinating air defense activities in the ground and air units of the Soviet Army in the field.

44. The European Satellites, North Korea, and Communist China have independent air defense systems modeled after the USSR's and integrated into the Soviet system. The major control centers are located in the respective capitals. Thus early warning information can be passed laterally among the Satellites or the air defense regions of the USSR as well as vertically to the central air defense control headquarters in Moscow.

45. Air defense of Soviet military establishments in the Satellites and occupied areas is the responsibility of the respective Groups of Forces and is provided from the antiaircraft artillery, tactical air armies, and early warning units assigned to these commanders. At present there is little evidence of unified command of Soviet territorial and Satellite air defense forces, as such, although operational control channels and possibly command channels for air defense are probably in the process of establishment at the present time. By the Warsaw Agreement of 14 May 1955, a combined military command for the USSR and European Satellites was established under Marshal Konev with headquarters in Moscow. This combined command will almost certainly provide an administrative framework for more effective control and integration of air defense forces.

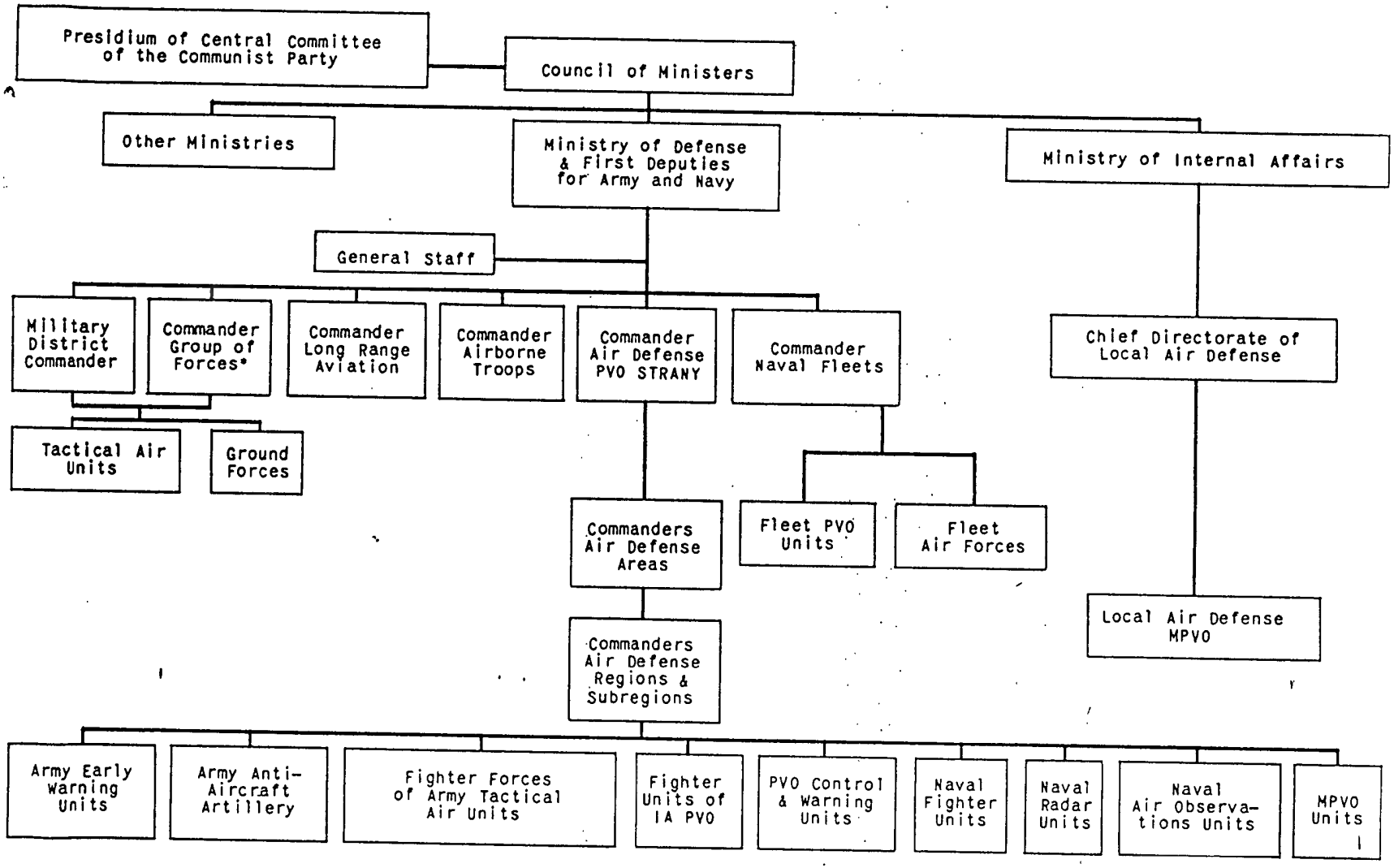
46. *Air Defense Personnel.* Sino-Soviet Bloc active air defense units are estimated to comprise about 880,000 personnel:

	Bloc	USSR	European Satellites	Viet Minh, North Korea, China
Fighter Aviation[1]	288,600	220,000	39,900	28,700
AAA	445,100	293,000	77,300	74,800
PVO Regions and Control Centers	62,000	52,000	2,000	8,000
PVO Hq. and Adm. Staff	2,750	1,500	500	750
Ground Observer Units	50,000[2]	N.A.	N.A.	N.A.
Radar Installations	34,000	22,000	7,300	5,000
TOTAL	882,450	588,500	127,000	117,250

[1], [2] See page 12 for footnotes.

CHART II

SOVIET OPERATIONAL AIR DEFENSE CHANNELS



* Soviet Forces in occupied areas.

In addition, there are substantial numbers of full-time local observers and passive air defense personnel; all men and women between the ages of 18 and 50 are subject to this service.

Bloc Fighter Organization, Strength, and Equipment

47. *Organization.* Fighter aircraft of the USSR comprise 280 regiments of which 123 are in tactical aviation, 102 in IA-PVO, and 55 in the Naval Aviation. In addition there are 64 regiments in the Satellite Army and Fleet Air Forces and 49 in the North Korean and Chinese Army and Fleet Forces. Geographic distribution of fighter regiments is estimated as follows:

Soviet Units	Number of Regiments
Northwestern USSR	38
Western USSR	62
Central USSR	36
Caucasus	36
East Central	19
Soviet Far East	54
East Europe	35
East Germany	20
Poland	3
Soviet Zone Austria	6
Hungary	3
Rumania	3
Other Bloc Units	
Bulgaria	11
Czechoslovakia	14
East Germany	8
Hungary	6
Poland	19
Rumania	6
China	42
North Korea	7
Albania	1 squadron
TOTAL	393

48. *The IA-PVO.* Those fighters known to be under PVO STRANY are assigned to IA-PVO, with an authorized strength estimated at 3,800 aircraft. The basic operational unit of IA-PVO is the division made up normally of three regiments. The division is the basic command echelon for control of actual intercept operations. The divisions in turn are subordinate to air armies or unidentified fighters formations.

49. The remainder of Soviet operational fighter aircraft are assigned to units of (a) the tactical air armies and military district air forces, and (b) Naval Aviation. These forces operate under a "multiple mission" concept which includes an air defense role.

50. *Strength and Deployment — Mid-1955.* The estimated over-all authorized (TO&E) strength of Bloc fighter forces is 14,600 aircraft while actual strengths are estimated at about 12,400 fighter aircraft.[4] Soviet fighter forces with an authorized strength of 10,400 constitute over 75 percent of the total Bloc fighter TO&E strength.

51. The largest number of fighter units in the Bloc are deployed in the Western USSR.[5] Most of the principal target and approach areas to the USSR are covered by presently deployed fighter forces with the exception of the North Central, North Eastern, and Central Asian border areas. Distribution of authorized (TO &E) fighter strength within the Bloc is as follows:

	Jet		Piston	
	Day	AW		Total
Eastern Europe	3,320	40	300	3,660
Soviet Western Frontier	2,570	40		2,610
Soviet Northwest	520	30		550
Moscow and Approaches	1,770	120		1,890
South Central Frontier	1,510	40		1,550
Ural Area	330			330
Siberian Baikal Area	190			190
Far East Area	1,970	30		2,000
Manchuria-China-North Korea	1,530		290	1,820
TOTAL	13,710	300	590	14,600

Footnotes from page 10.

[1] Includes IA-PVO (77,400) and fighter elements of Tactical Air Armies, Military District Air Forces, and Naval Aviation.

[2] There is insufficient evidence to permit further subdivision by geographic areas.

[4] Actual aircraft strengths average approximately 85 percent of TO&E, although this varies considerably as new aircraft are phased in. (See Appendix B for estimate of strength by year.)

[5] See Map III for deployment of air defense equipment.

52. The Soviet fighter forces are now all equipped with jet fighters and the keystone of present programs elsewhere in the Bloc is the re-equipment of fighter forces with jet fighters. At present, only 50 piston fighters (actual strength) remain in the European Satellites. Poland is completely equipped with the FAGOT. There was a reorganization of the East German Air Force in 1954 but little increase in strength and no indication of resumption of jet training. In the Far East, Communist Chinese–North Korean actual fighter strength increased from 1,050 to 1,220 while TO&E aircraft strength increased from 1,330 to 1,584 during the period 1 January 1954 to 1 April 1955. As a result of a series of redeployments, the bulk of the Chinese jet fighters are now concentrated in the Shanghai area, and the forces in Manchuria have been reduced.

53. *Equipment.* Present Bloc fighter forces are primarily equipped with two types of aircraft which from a performance standpoint can be used for air defense: FRESCO (MIG-17) and three versions of FAGOT (MIG-15). While these are all employed as day interceptors, some of the FRESCO's are now equipped with AI (Air Interceptor) radar. The FAGOT could also carry AI radar but it is unlikely that this conversion will be made. (See Appendix C for performance characteristics of these fighters.)

54. Both of the above types are armed with 23mm or a combination of 23mm and 37mm guns. All of these guns have a relatively low muzzle velocity of 2,250 ft./sec. The FAGOT is equipped with a gun sight which is equivalent to the USAF K-14 with manual range input. Some models of the FRESCO are equipped with this sight but it is also probable that some have sights with radar ranging.

55. Two new fighter types have recently been observed in considerable numbers. Both were twin jet swept-wing fighters of which one, the FLASHLIGHT, is probably an all-weather fighter and the other, the FARMER, appears to be capable of level flight speeds in excess of Mach 1. Both of these aircraft are estimated to be in serial production and a few of each are estimated to be in operational units.[6] The FARMER is believed to have a radar range type gunsight. The FLASHLIGHT is estimated to be equipped with two large caliber guns, probably 37mm. It is also possible that some models carry air-to-air rockets. The fire control system of the FLASHLIGHT almost certainly includes an airborne intercept radar with probable search ranges up to 16 nautical miles and lock-on ranges up to 10 nautical miles.[7]

56. The over-all effectiveness of present Soviet interceptor forces is probably limited by the number of AI-equipped interceptors, the low cyclic rate and muzzle velocity of the guns, and the limited fire control capability. In addition, the FAGOT is limited to some degree by undesirable flight characteristics at high speed and by low duration of fire. The FAGOT has a good degree of effectiveness under visual intercept conditions against current B-47 jet bombers. The FRESCO and FARMER will be more effective against jet bombers due to their higher speed, ability to initiate diving attacks, and greater stability at higher speeds. The AI equipped FLASHLIGHT will be considerably more effective than the earlier AI equipped fighter (possibly FRESCO) against jet bombers under all weather conditions due to better armament, and better fire control and AI search capability.[8]

57. *Airborne Radar.* There is considerable evidence of employment of AI radar and recent sightings tend to confirm that it is installed in the FRESCO and almost certainly is installed in the FLASHLIGHT. We believe it could also be installed in the FAGOT. Although there is no evidence of tail warning radar on Soviet fighters, we estimate they could be so equipped. Present Soviet airborne IFF SRO equipment is similar in performance to the US MARK III system. It appears to operate inside the 153-187 MC band

[6] See Appendix C for performance characteristics of Bloc fighters.

[7] AI radar ranges are under study and are subject to revision.

[8] See Appendix B for estimated number in operational units.

employed by the MARK III but has 28 identification pulse groups compared to six for the MARK III. This set when combined with the interrogator responder "FISHNET" will provide a reliable identification system but has a low traffic handling capacity. This system could be used to extend the GCI range control of fighters. Soviet naval IFF compatible with "FISHNET" has also been observed.

Antiaircraft Artillery

58. The Soviets continue to place considerable emphasis upon AA artillery. Technical and administrative control of AAA units is provided by the Main Directorate of Artillery Forces of the Soviet Army. However, the commander-in-chief of PVO STRANY has a large number of AAA units under his operational control, and probably coordinates the efforts of AAA elements attached to ground, naval, and air components which contribute to the mission of PVO STRANY but are not subordinate to it. Operationally, AA artillery units probably come under the control of the PVO commanders of the regional and subregional headquarters as do units of IA-PVO. Warning information from radar sites is passed to a control center and pertinent AAA fire direction center which alerts the AA artillery. Usually, a system of zones from the control center is set up, so that when a target reaches a certain line AAA is alerted for action.

59. *AA Guns.* Two significant post-World War II developments in heavy AA guns have been noted. The 100mm gun, now standard, was first observed in Moscow in 1951. It may be operated manually or by remote control. A new heavy gun of at least 122mm caliber was first seen uncovered in the 1955 May Day parade in Moscow. It is estimated to have an effective ceiling of from 40,000 to 45,000 feet with conventional projectiles. Despite its altitude advantage over the 100mm gun, it is possible that the latest heavy gun may not be widely used, particularly if operational quantities of guided missiles become available in the near future. (See Appendix C for operational performance characteristics of AA guns.)

60. The 85mm AA gun was the standard Soviet heavy weapon from 1939 until the 100mm gun appeared. Although considered obsolescent, it is still deployed widely throughout the Soviet Bloc both in the PVO and in field divisions. These guns are being turned over to secondary and Satellite defenses as soon as they can be replaced with the 100mm. We estimate that the 100mm gun, director, and associated "WHIFF" radar as a weapons system can engage subsonic aerial targets within the range of the gun itself. A similar fire control system probably will be used with the new 122mm gun.

61. *Proximity Fuses.* The Soviets are fully capable of developing the necessary electronics components and vacuum tubes for use in proximity fuses. They have acquired many thousands of late model American VT fuses. During the period of this estimate, they should be able to produce quantities of proximity fuses for use in the air defense system.

62. *Automatic Weapons.* The 37mm M1939 gun has been the standard Soviet light antiaircraft weapon but it is now being replaced by a 57mm automatic weapon. The 37mm probably will be encountered in increasing numbers in the Satellite forces as it is phased out of Soviet units. The 57mm automatic is designed to engage subsonic aircraft up to 15,000–18,000 feet. The angular tracking rate is not known. It is considered likely that a radar-director fire control system has been provided in addition to on-carriage mechanical sights for all-weather operation. A mechanical on-carriage sight would limit its effective ceiling to about 6,000 feet. A high cyclic rate (500 to 600 rpm. per barrel) 30mm multibarrel automatic gun is expected to become a standard low altitude antiaircraft weapon.

63. The standard machine gun assigned to Soviet AAA units has been the 12.7mm Degtyarev M1938, but it too is being replaced. The replacement weapon is a 14.5mm machine gun which is available in single, dual, and quadruple mounts.

64. *Searchlights.* Soviet searchlights vary in diameter from 40cm (15.7 in.) to 200cm (79 in.). Some of the 200cm diameter searchlights probably have radar units as integral parts of the mount.

65. *Unguided Rockets.* During World War II the Soviet forces used ground-to-ground rockets for defense against low level aircraft attacks, but with little effectiveness. Soviet interest in developing unguided rockets for antiaircraft defense was probably increased by the availability of German scientists and rocket developments which were exploited after World War II. The Taifun, a German unguided rocket designed for strategic defenses, probably formed the basis for Soviet research projects. A two-stage, high-level rocket developed by Germans in the USSR, called "Zenith," has also been reported, and we have indications that it could be available now in limited quantities. Barrage-type rockets for use against low level attacks could be in a late stage of development and possibly available in limited quantities in 1957. A fire control system for unguided AA rockets will probably be a modification of that now used with the 100mm AA guns.

66. *AAA Strength and Deployment.* It is difficult to determine the allocation of AAA weapons. Moscow is apparently the first to be supplied with new weapons. As they become available in greater numbers, they are allocated to other important areas in the Soviet Union and finally to the Satellite countries. There is some indication that the Soviets are now strengthening AAA defenses of occupied airfields in the European Satellites. The lack of adequate AAA defenses at such airfields has been a deficiency of postwar Soviet defenses. We estimate that the USSR now has about 13,850 operational AA guns, including 50 122mm guns, 3,000 100mm guns, 2,900 85mm guns, and 7,900 37mm and 57mm guns. There are large stockpiles of serviceable 37mm and 85mm AA guns.

67. Heavy AA guns are deployed in some 286 regiments of which 172 are in Soviet forces, 44 in European Satellite forces, and 70 in the Asian Bloc forces. In addition, light AAA units are deployed throughout the armed forces of the Bloc in regiments of AAA divisions, AAA regiments and battalions of line divisions and corps, and batteries of heavy tank and self-propelled gun regiments. (For geographic deployment of AA guns, see paragraph 121, page 25).

68. *Guided Missiles.* Based on the equipment, facilities, and personnel connected with German World War II developments and upon intelligence on subsequent activities in the USSR, it is estimated that the USSR could now have an improved version of the Wasserfall with the following characteristics: range 30,000–35,000 yards, altitude 50,000 feet, a two radar mid-course guidance system with a semiactive terminal homing, and a warhead under 600 pounds. This would significantly increase the kill probabilities against Allied bombers, even in bad weather. In July 1953, an installation was sighted in the Moscow area which may have been a guided missile launching site. Between mid-1954 and the present approximately 23 more such sites have been observed in the Moscow area plus one in the Leningrad area.

69. Other than these installations there is no evidence available concerning actual Soviet deployment of guided missiles for air defense at the present time. Nevertheless, we estimate that the Soviets do have some surface-to-air guided missiles in operational use at the present time and that they could have an air-to-air missile.

Control and Warning

70. *Organization.* The USSR has an extensive warning and control system, although the precise means by which the various elements and levels are integrated or the precise designation of units are not known. Top-level control is probably exercised from Moscow through the headquarters of PVO STRANY. The control and warning organization of PVO STRANY probably corresponds to the regional and subregional PVO organization and provides over-all coordination of AAA forces, fighter forces, and control and warning at these various levels.

71. In addition to warning units of PVO STRANY, tactical air elements of the Army and Navy have their own organizational radar which is operated for the control and protection of their respective forces. For air defense purposes, these radar units are also available to PVO STRANY and are probably integrated at the same geographic organization levels as the control and warning units. Each air division also has its own divisional GCI radar for control of interceptors, which results in considerable duplication of radar and probably accounts to some degree for the high radar density in many regions. Probably one of the greatest weaknesses of the Soviet air defense system has been a lack of adequate decentralization of command responsibilities below the regional or subregional headquarters causing duplication of radar and loss of time in command reaction. At present, intercepts by fighters are largely controlled by the divisional radar but the Soviets are probably now in the process of decentralizing to permit control of interceptions by individual radars.

72. *Equipment.* Soviet radar has steadily improved from the native World War II PEGMATIT and RUS 2 EW radars operating in the 70 MC band. In 1949 the DUMBO radar appeared which was essentially an improvement of the earlier Soviet World War II radars. In 1951, a Soviet version of the US antiaircraft fire control radar SCR–584, designated "WHIFF," began to appear in quantity. Also in 1951, a new Soviet EW and GCI ground V-beam radar designated "TOKEN" similar to the US AN/CPS–6B, was first observed. In 1953, two different EW type antennae arrays were observed in the USSR and in Czechoslovakia, designated "GAGE" and "WOODGAGE," respectively. A height-finding radar designated "PATTYCAKE" appeared at the same time. In 1952, a new EW radar designated "KNIFEREST" and operating on 73 MC began to replace the older "DUMBO" radar and in 1953, a new antenna, designated "FISHNET," was identified as an IFF antenna which, in conjunction with the airborne transponder SRO, forms an IFF system comparable to the MK III system used by the Allies in World War II.

73. The following estimate of Soviet radar capabilities is based largely on the composite characteristics of the DUMBO, TOKEN, and KNIFEREST radars, which are in most widespread use at the present time. We estimate that the capabilities of the Sino-Soviet Bloc early warning radars are such that the maximum altitude coverage extends above 45,000 feet and may extend to about 60,000 feet, depending on factors such as range, size, and aspect of target. The ranges at which Block EW radars provide coverage with a 50 percent probability of detection are estimated to fall within the limits indicated in the following table:

EARLY WARNING

Altitude (feet)	Range (nautical miles)		
	B-47 size	B-36 size	Jet Fighter
25,000	100–150	115–185	60–90
35,000	125–160	135–200	50–80
45,000	125–170	145–210	40–70
55,000	125–180	145–210	limited

74. The ranges at which Bloc radars provide GCI coverage are estimated to fall within the limits indicated in the table below. To effect interception at bomber detection ranges, Soviet fighter aircraft would require transponder beacons in order to permit tracking the Soviet fighters as well as the intruding bombers. The USSR has the capability to utilize transponder beacons.

GROUND CONTROL INTERCEPT

Altitude (feet)	Range (nautical miles)		
	B-47 size	B-36 size	Jet Fighter
25,000	60–90	70–110	35–55
35,000	75–95	80–120	30–50
45,000	75–100	90–125	25–40
55,000	75–110	90–125	limited

75. *Numbers and Deployment.* The Bloc has carried out a massive postwar radar construction program. At present it is estimated to have operational some 1,075 early warning and GCI radar, including no less than 450 TOKEN types and 25 of the new GCI radars. In addition, we estimate they now have some 600 fire control radars and about 1,000 sur-

face IFF interrogators. The early warning and shipboard GCI radars have been generally deployed throughout the Bloc with the major concentration being in the European Satellites, Western USSR, and the Maritime Provinces of the Far East. In the West, a radar chain extending from the Barents Sea to the Caspian Sea provides radar coverage of the Western USSR and the European Satellites. In the Far East, radar coverage extends from the Bering Straits area south to Hainan Island in the South China Sea with the exception of a few isolated gaps. In the course of normal operations, Soviet naval units provide incidental extension of this early warning chain. (See Paragraph 118, page 24, for deployment of radar by region.)

76. *Ground Observer Posts.* The USSR also has what is believed to be a very extensive ground observer system, which consists of the naval observer units (SNIS) manned by Soviet naval personnel and the VNOS, a joint Army/civilian agency within the USSR, (which also operates radar) and corresponding Satellite organizations. The exact number of observation posts operated by these organizations is not known.

Communications

77. *Organization.* The precise nature of the Soviet communications system is not known, but on the basis of the North Korea-Manchuria network, both landline and radio communications are employed between early warning stations, airfield GCI stations, and control centers. More modern UHF equipment is now known to be in use in some areas.

78. In order to accomplish the control and coordination function, a knowledge of the air situation within and adjacent to the air defense region or subregion is necessary, and it is therefore probable that the early warning stations channel their reports, perhaps through subregional centers, to the regional control centers where major operational decisions are made. Filter centers are probably employed in conjunction with subregional centers to coordinate the visual and radar information and eliminate duplications or erroneous information. Control centers probably exist at the regional and subregional headquarters and at the Central PVO headquarters. In addition, control centers are probably required at each fighter division headquarters and at all AAA organizational levels.

79. Communications pertaining to hostile air traffic are probably reported from the early warning radar site to the subregional, and area headquarters. Coordination between local AAA and fighter forces is probably accomplished on an information basis at the subregional control center, perhaps by assignment of liaison personnel. Major command decisions, however, probably occur at the regional center with decisions being passed down to the AAA and fighter units through the fighter control center. At the same time, information is probably passed laterally between regional headquarters and vertically to the area headquarters. We estimate that there are approximately 240–260 control centers in the Soviet Bloc air defense system consisting of the following:

Area Defense Centers	2
Regional Control Centers	30–40
Subregional Control Centers	80–90
Divisional Control Centers USSR	91
Divisional Control Centers (European Satellites)	17
Divisional Control Centers (Asian Bloc)	18

80. *Air-Ground Communications Equipment.* Until recently, the Soviets primarily utilized HF equipment for air-ground communications. The standard communications installation in Soviet fighters was an improved version of World War II equipment. We believe that this equipment has been supplemented beginning in 1952 by four-channel VHF equipment. The ground equipment has been employed in mobile trucks containing one or more transmitters and as many as four receivers, covering the low, medium, and high frequency bands. A VHF transmitter and receiver between 100 and 150 MC now has been added to this system. To date there is no indication of changing the air-ground equipment to UHF.

81. *Ground Communications Equipment.* For ground communications, the Soviets use ordinary and high speed telegraph, radio, telephone, teletype, and facsimile and multiplex radio telephone for both military and civil needs. The land lines are mainly concentrated in European Russia, thinning considerably north of Moscow, Leningrad, and in the Southern Urals, and East into Siberia which has only one main route with several subordinate branch lines. High, medium, and low powered transmitters for high speed telegraphy and ordinary voice communications in the low, medium, and high frequency 30 KC to 30 MC range are scattered thickly through the European Soviet areas. They provide the sole means of rapid communications in many areas which are sparsely settled or where climatic conditions make it impossible or difficult to maintain land lines.

82. While there is no evidence of Soviet use of scatter techniques in long distance communications systems, there are strong indications that they are aware of the usefulness of these techniques, and their advantage of lower susceptibility to jamming and intercept. We estimate that the USSR has the capability to develop such systems and may have them in current operation.

83. During the past few years, the USSR has been using UHF relay station equipment. This equipment provides up to 16 voice or 48 teletype subcarriers. It may be used in mobile installations for extreme flexibility or may be sited at permanent locations. Operational ranges up to about 50 nautical miles are possible, depending upon the intervening terrain. Recent reports indicate this type of equipment has been installed in East Germany and is functioning in an air warning net which is believed to be linked to installations in other Bloc countries.

84. *Automatic Computation and Data Handling Equipment.* Soviet equipment known to be available for this purpose includes land lines, low, medium, and high frequency radio links, multichannel microwave radio links, and television or broad-band radio links. This TV link equipment could be employed to transmit data very rapidly or even transmit TV pictures of complete status boards. Processing of data for transmission by any of the above mentioned systems would greatly increase data handling capabilities. Computers would play an important role in such a system. The USSR is developing, and may now have in operation, automatic computation and data-handling devices.

85. *Radio Navigation Equipment.* The Soviets are placing heavy reliance upon ground and airborne radio direction-finding aids for the major portion of their air navigation, including approach and landing. Soviet and Satellite territory and airfields are well supplied with ground direction finders, omnibeacons, and rotating beacons. Requirements still exist for more precise navigation and landing aids. There is considerable evidence of development work being accomplished to provide a more precise localizer in the VHF or UHF band and incorporating distance measuring equipment. Ground located VHF direction finding facilities are available. There is a standard landing procedure for fighters which uses a medium frequency homing beacon and a marker beacon at each airfield. Recently several GCA type radars have been sighted at some airfields. We estimate installations will be made at key fighter fields.

Electronic Countermeasures

86. *Active Jamming Equipment.* The current Soviet capability for seriously disrupting Western long-range communications and radio navigation systems gives them a high capability for jamming such radio communications and navigation systems as may be used in an air attack against the Soviet Bloc. Research is now being conducted on magnetrons, suitable for jamming in the S and X band, as well as the decimeter ranges but we have no information of any equipment that utilizes these magnetrons. The USSR probably has a capability for electronic jamming up through 12,000 megacycles and possibly through 46,000 megacycles.

87. *Passive Countermeasure Equipment.* We have evidence of extensive Soviet interest in the electronics intercept and analysis equipment. We also have evidence that electronic

reconnaissance is being conducted by the Soviets. We estimate that the USSR will make extensive use of chaff in electronic warfare. The Soviets have also indicated interest in antiradar coatings and at least one German scientist concerned with World War II radar camouflage may still be in the USSR.

88. *Soviet Vulnerability to Electronic Countermeasures.* The Soviets are aware of the effectiveness of countermeasures' against radar and have the capability of developing devices which would make their equipment less vulnerable to jamming or spoofing. It is not presently possible to estimate the exent of development and/or current incorporation of such features in operational equipment. Known Soviet low and high frequency communication equipment, ground and airborne, is susceptible to the usual types of jamming. Their employment of VHF for air/ground communication would make jamming more difficult. Increased Soviet employment of highly directional microwave point-to-point communication equipment has also greatly reduced their vulnerability to jamming.

89. Conventional Soviet radio navigation aids such as omnidirectional landing and route beacons are individually susceptible to long-range jamming. All other systems or aids known to be used by the Soviets, suitable for fighter operation, are vulnerable to both spoofing and jamming. The active and passive electronic missile guidance systems estimated to be in existence are also all susceptible to electronic countermeasures.

Air Facilities

90. During the last several years, the USSR has put great emphasis on airfield development, particularly in perimeter areas. Since 1950 airfield construction has been extended in the Khabarovsk Vladivostok area and north-eastward to the Chukotski Peninsula, thus strengthening the perimeter network of airfields. Recent construction activities have also taken place in the Murmansk-Leningrad areas, the Baltic States, South Ukraine, Crimea, and Caucasia. A general improvement of airfields along the Far East supply line and the construction of better facilities at civil airports have also been noted. It is believed that runway construction inside the Soviet Union has been extensive in recent years, and apparently minimum requirements for concrete runways at home bases have been standardized at 5,900 to 6,000 feet for fighters and light bombers and 7,900 to 8,200 for medium bombers.

91. In nearly all areas of probable operations, there appear to be adequate networks of airfields for the employment of present Bloc fighters forces. The principal exceptions are in the northeastern and north central Siberian areas. In the northeastern area, extensive operations at the present time would probably still entail the use of substandard fields even though airfield construction has been in progress in the Chukotski area since 1952. In the north central area, additional improved airfields would also be required even though some airfield construction has been carried out along the Arctic coastline in the past few years. Thus, for optimum air defense coverage, extensive additional airfield construction in these areas is required through the period of this estimate.

92. The existing airfield net in the European USSR and Satellites affords an adequate fighter base capacity for present aircraft, but in a major war bases in some sectors might not provide sufficient flexibility of fighter forces for air defense in addition to meeting the increased needs of other types of aircraft. The need for greater flexibility in certain areas is apparently recognized by the Soviets, since new airfield construction is still taking place in the Satellites, where the number of major airfields increased during 1954 from 98 to 112. There are at present 20 additional airfields under construction, of which 17 are in Poland. Three new runways were added in East Germany and there are indications that more will be built in 1955. Work continues on Gross Dollin, the new airfield near Berlin, with an 11,000 foot runway. In Czechoslovakia, four long grass strips have been added, bringing the total of this type to nine. In several of the Satellites, there have been signs of reactivation of former grass landing grounds and two of the "forest landing grounds" in East

Germany were used for the first time in maneuvers.

93. Estimated availability of airfields of over 4,000 feet in length in the Sino-Soviet Bloc is as follows:

Soviet Western Frontier	162
Soviet Northwest	39
Moscow and Approaches	179
South Central Frontier	114
Ural Area	55
Siberia-Baikal Area	55
Far East Area	149
TOTAL IN SOVIET UNION	753
Eastern Europe	241
Asian Bloc	208
TOTAL	1,202

Logistic Support, Maintenance, and Training

94. The technical supply system is well organized to meet Soviet air defense requirements. Since antiaircraft installations, airfields, and radar stations are located adjacent to populated areas and main transportation and communications lines to most areas, the major Soviet problems of logistic support arise in connection with the peripheral areas, particularly the northern and northeastern Siberian areas and in Communist China, North Korea, and North Vietnam where adequate transportation facilities do not exist. These problems lie mainly in the transportation of parts, and in the availability, transport, and storage of jet fuels.

95. Very little information is available on the exact location of jet fuel storage points or the amount of fuel stored. It is known that jet fuel in large quantities is stored at the refineries, at regional distribution points, and at air army central fuel depots. In addition, limited amounts of fuel are stored on the operational airfields. The over-all availability of jet fuel is believed to limit the amount of flying accomplished at the present time to seven hours per fighter pilot per month. We believe this limitation is probably due to: (a) transportation deficiencies; (b) increased requirements due to rapid build-up of Soviet jet forces; (c) the allocation of considerable quantities of jet fuel to a reserve storage program; and (d) limited base storage facilities.

96. Intelligence is lacking for a complete appraisal of the Soviet military aviation maintenance system as it affects fighter aircraft, although certain limitations are indicated. The maintenance system is highly centralized and controlled, with rigid definitions of duties and responsibilities which might be cumbersome and subject to breakdown in time of war. Inspection requirements are excessive and technical personnel are not used in the most economical manner. On the other hand, the level of training of technical personnel seems to be good and technical manuals are adequate. Historical evidence indicates Soviet maintenance capabilities during and immediately after World War II were substantially lower than those of the US. Since that time, there appears to have been slow but steady improvement, probably influenced to a large degree, by the retention in the service of trained maintenance specialists and the introduction of the jet fighter which is easier to maintain.

97. It is estimated that a current serviceability rate for present jet fighters on the order of 85 percent of assigned aircraft can be achieved under normal operating conditions. For tactical fighter units an initial maximum serviceability rate of 85-95 percent could be obtained following a complete or partial stand-down. This rate could be maintained for the first day or two of intensive operations but would probably decline to around 50 percent through the sixth or seventh day, followed by a gradual buildup to around 60-65 percent sustained rate. Initial maximum serviceability rate for air defense fighters would probably be around 95 percent since these forces are held in a semi-stand-down condition until committed. After commitment, the serviceability rate of these fighters would probably drop below that of tactical fighters due to recovery at alternative bases, causing increased logistic and maintenance problems. As new and complicated all-weather fighters are introduced, the initial maximum serviceability rate will be lowered considerably, probably to around 50 percent.

98. Under extreme cold weather conditions in the Arctic areas, serviceability rates of all types of equipment will be considerably reduced even though the Soviets have designed their equipment for low temperatures and have wide Arctic operational experience. Not only is maintenance more difficult, but the logistic problem is magnified by increased requirements for heavy clothing and special ground equipment, such as heaters and aircraft shelters. This, together with the fact that the Arctic areas are usually not served by adequate transportation facilities and the fact that morale is generally lower will seriously limit maintenance and serviceability rates.

99. *Maintenance.* Soviet electronics equipment is similar to Western equipment and consequently maintenance problems are probably comparable. Our knowledge of the operation of Soviet electronics equipment indicates that it is reliable and well-maintained. Soviet equipment has also been designed for use under wide temperature ranges. Captured Soviet equipment which has been tested has been found to be within current US Joint Army-Navy (JAN) specifications.

100. *Training.* Intelligence currently available is insufficient to permit a satisfactory assessment of training of air warning personnel. Considerably more information is available concerning pilot training in the USSR. A fighter pilot is believed to acquire approximately 100 hours of flying time in flying school. To this could be added the DOSAAF[9] flying time of about 45 hours which pilot candidates receive prior to entering the flying school. In the past Soviet and Satellite pilots reported to operational units with only about 100 hours flying time in trainer type aircraft, without having flown tactical aircraft and without having received gunnery or night-flying experience. At the present time, however, the Soviet training establishments have a total of some 700 jet fighter aircraft which are being used for pre-operational training. This type of training is also carried out to a considerably lesser extent in some European Satellites.

[9] All Union Voluntary Society for Cooperation with the Army, Aviation, and Fleet.

101. Soviet fighter pilots receive only about seven hours flying time per month after joining an operational unit. We believe that approximately 30-35 fighter pilot schools exist in the USSR which probably produce an average of 100 pilots per school each year or a total of 3,000 to 3,500 pilots. Jet training, however, has been increasingly conducted by the pre-operational flying schools and by operational units.

102. The current training program of the IA-PVO units is not known. However, information available for 1950 indicated that the training goals were to acquire fully the technique of interception and destruction of *large hostile* air formations through coordination of all air defense weapons. We estimate that these goals now include interception and destruction of single aircraft and small formations of jet bombers as well as large formations. Night flying was known to be limited in 1950 to nights when the natural horizon was visible and probably averaged around six hours per pilot annually. Although the night flying standards have increased considerably since that time, they are still probably well below US standards.

103. We believe that there is no instrument school available as such in the Air Forces of the Soviet Army, other than that for the training of bombardier-navigators in Soviet Long-Range Aviation. Instrument training for fighter pilots is conducted in operational units.

104. In general, training in the European and Asiatic Satellites is patterned after that in the USSR, but the standards are believed to be lower.

Passive Defense

105. *Organization.* Passive air defense is carried out by the civil organization known as the MPVO which is subordinate to the MVD. Each constituent and autonomous republic in the Soviet Union has its own MVD and a directorate of the MPVO. However, the MPVO directorates have little independence and receive policy and administrative guidance from the All Union MVD in Moscow. The MPVO system is well integrated in the governmental

structure of major cities and industrial areas vulnerable to air attacks. Existing civil agencies such as health and fire departments are utilized to implement MPVO measures. City officials rather than MVD personnel are responsible for directing local air defense activities. MVD personnel actually enforce local air defense policies as formulated in Moscow.

106. *Deception.* In Korea, false road convoys were employed at night to lure United Nations aircraft into flak traps or hanging cable defenses. Dummy aircraft, airfields, and field guns were also noted. To date there have been no observations of camouflage on a mass area basis such as construction or simulation through radar camouflage of false cities, factories, and lakes. However, these techniques were used by the Germans during World War II, and it must be assumed that the Soviets are aware of this potentiality. Some sites have been observed in the USSR and in some of the Satellites which may be dummy airfields, but no replicas of large elaborate airfields have been noted.

107. *Aircraft Dispersal.* In combat areas during World War II, the general Soviet practice was to avoid high concentrations of aircraft on a particular field. The necessary operational concentrations within a given sector was achieved by using satellite fields around a major airfield. The current practice of utilizing natural surface airfields even where adequate hard surface runways are available indicates that the Russians are still dispersal-conscious. Furthermore, the ability to use natural surface airfields is a tremendous asset to a dispersal concept even though some maintenance and operational problems may be magnified. By using a mass take-off technique, the Soviet air forces have demonstrated an ability to evacuate a regiment of fighter aircraft from a natural surface field within a period of three minutes, although several hours advance notice may have been given. A current practice of the Soviet air forces is to base one or two fighter regiments at one field. During wartime, in areas subject to air attack, it is probable that no more than one fighter regiment will be based at any one field.

108. *Underground Installations.* Some peripheral cities such as Vladivostok, Baku, and Sevastopol have retained and improved elaborate defensive tunnel systems constructed during World War II. Some airfields in the Far East are equipped with underground storage space and repair shops, and there have been several reports of underground hangar construction in Germany, Poland, and Rumania. Underground command posts and filter centers have been reported in Hungary and Bulgaria and it is assumed that similar installations exist in major cities and defense centers throughout the Soviet Bloc. Extensive underground installations for the protection of population groups are believed to exist in only a few major cities.

109. *Training.* Passive defense against air attack is included in training programs throughout the Soviet forces. Field manuals and pamphlets are published for troop issue, and defense against chemical attack is included in school curricula. Recent maneuvers in East Germany have included defensive tactics against atomic weapons and indicate that Soviet military leaders are aware of the problems of survival in atomic warfare. There is no known organization within the military forces charged solely with bacteriological warfare defense but it is probably that the military medical organization has this responsibility. Troop training stresses discipline with regard to avoiding water, foodstuffs, and areas of contamination. The current issue gas mask is believed to afford adequate protection against BW Aerosols.

III. TRENDS IN BLOC AIR DEFENSES THROUGH 1960 [10]

110. The Bloc, and particularly the USSR, is continuing its intensive efforts to improve the existing air defense system in order to cope with the growing Western capabilities. (See Section I). The objectives of the Bloc air

[10] The estimates in this section are based on the assumption that neither domestic or international political factors nor unexpected technological breakthroughs will alter the general nature of weapons programs as now envisaged in the Bloc and the West.

defense planners during 1955–1960 will almost certainly be to: (a) develop and produce in quantity equipment with performance characteristics capable of combating the Western air threat; (b) rapidly improve the training of air defense units; (c) develop better communications facilities; (d) improve and increase the number of airfields; and (e) improve their air defense organization.

111. To meet these objectives would be a task of such magnitude as to require a major effort during the 1955–1960 period. Achievement of a high degree of effectiveness would require a very large scale program of research, development, and production in order to keep pace with Western developments. If our estimate of their analysis of the air defense problem is sound, the Soviets will probably seek to do the following:

a. Develop all-weather interceptor aircraft with airborne intercept equipment able to operate from low altitudes to 65,000 feet and at speeds better than 1,150 knots;

b. Develop improved AA rockets and missiles;

c. Develop an early warning system around the entire Sino-Soviet Bloc: to provide early warning as far out as 750 miles from Bloc border at altitudes up to 80,000 feet;

d. Develop airborne early warning aircraft and associated equipment;

e. Develop a more effective communications system, and provide more land lines;

f. Develop an integrated automatic data handling system;

g. Continuously train personnel to operate all elements of the air defense system;

h. Improve and enlarge existing airfields and construct new airfields;

i. Modify the command policy of the air defense organization to permit operational decisions at lower levels;

j. Improve range and altitude capabilities of GCI radar; and

k. Develop countermeasures equipment to render hostile navigational and bombing radar ineffective and to prevent jamming of the radar and communications equipment of the Bloc air defense system.

Trends in Strength and Equipment

112. *New Fighter Types.* The USSR will probably introduce additional new day and all-weather fighter types during the period of this estimate as indicated in Appendix B. As these new fighters are phased in, the older types will be dropped from the order of battle so that all FAGOTS will probably be replaced by 1957. We estimate the FRESCO will probably be further developed, if not so already, by the installation of an 8,000 lb. thrust engine and will continue to be used throughout the period of this estimate but in reduced numbers by 1960. By 1960, we believe the Bloc will have both day and all-weather fighters with speeds up to 850 knots, time to climb to 40,000 feet of about two minutes, and combat ceilings up to 62,000 feet. (See Appendix C for estimated performance characteristics of new fighters.)

113. *Over-all Fighter Strength Through 1960.* We estimate that there will probably be only a modest increase in authorized Bloc fighter strength from some 14,600 in 1955 to 15,530 in 1960. However, a far more significant increase will probably take place in the proportion of all-weather fighters, which we estimate will grow from 300 in 1955 to 6,100 by 1960. Estimated total TO&E strengths by year are as follows: [11]

	1956	1957	1958	1959	1960
USSR					
Jet Day	9,500	8,100	6,900	6,300	6,100
Jet AW	1,000	2,500	3,800	4,500	4,800
European Satellites					
Jet Day	2,530	2,480	2,380	2,180	1,880
Jet AW	0	100	200	400	700
Manchuria-China-Korea[1]					
Piston	100	100	100	100	100
Jet Day	1,670	1,750	1,700	1,570	1,350
Jet AW	30	100	200	350	600
TOTALS	14,830	15,130	15,280	15,400	15,530
AW	1,030	2,700	4,200	4,950	6,100
Day	13,800	12,930	11,080	10,450	9,430

[1] We believe a small Viet Minh Air Force will be developed during the period of this estimate.

[11] For strength by type and phasing in of aircraft, see Appendix B.

114. *Future Radar Coverage.* On the basis of observed trends in Soviet radar development and deployment, we estimate that the USSR will gradually replace many of its present radars with improved radars. By 1960 the range coverage capabilities of Soviet EW and GCI radars will probably be increased by as much as 50 percent (within propagation limits) over the ranges listed in the table in paragraph 73. Against a B–47 size target EW coverage will probably extend to 100,000 feet by 1960 and GCI coverage could extent to as much as 85,000 feet.

115. Estimated Soviet air defense programs through 1960 would provide operational radar as follows:

Equipment	Mid-1955	Mid-1956	Mid-1957	Mid-1958	Mid-1959	Mid-1960
TOKEN	450	525	600	600	600	600
70 MC Types	600	650	700	675	665	650
New EW	....	....	25	75	150	200
New GCI	25	150	300	400	400	400
Fire Control	600	650	700	650	600	500
New Fire Control	25	200	400	600	800	900
IFF Interrogator	1,000	1,250	1,500	1,700	1,900	2,000

116. Priority deployment of the radar indicated above will probably be made to the Western and Southwestern frontiers of Bloc territory from Murmansk to the Caspian Sea, in the Maritime Provinces of the Far East, and perhaps to a few internal areas. As improved equipment appears in these high priority locations, the shift of presently available TOKEN types to lower priority areas now covered by obsolete equipment, will also result in the improvement of detection capabilities in those areas. As the average detection range of Soviet radar is increased by the build-up of TOKEN strength and the introduction of improved radar types the general disposition of the equipment may be expected to spread in order to realize the full advantage of the increase in range capability.

117. Such a spread should enable more complete coverage to be afforded Arctic areas where penetrating aircraft enroute to important target areas might be expected to enter Communist territory. Increased detection coverage of the south central USSR border area adjacent to Iran and Pakistan might also be anticipated, and an increased flow of radar into China is also to be expected. We believe that by 1956 sufficient TOKEN radar will be available to provide complete coverage in the area between Hainan Island and Shanghai. Tracking facilities to back up the improved coastal detection capability will probably appear first in a zone some 100–150 miles inland from the coast, and in the vicinity of important inland cities such as Hankow and Changsha.

118. *Radar Deployment.* Estimated geographic deployment of Bloc early warning and ground control intercept radar is as follows:

Area	Estimated Number of Radar					
	1955	1956	1957	1958	1959	1960
Eastern Europe	300	300	300	300	300	300
Soviet Western Frontier	150	175	200	200	200	200
Soviet Northwest	50	75	100	125	125	125
Moscow and Approach	175	175	200	200	200	200
South Central Frontier	50	75	100	125	125	125
Ural	25	50	100	125	125	125
Siberian Baikal	0	5	100	125	140	150
Far East	195	200	200	200	200	200
Manchuria, China, Korea	130	245	325	375	400	425
TOTAL	1,075	1,325	1,625	1,750	1,815	1,850

119. *Communications.* Considerable improvement in Soviet air defense communications is probable through 1960, as the USSR has displayed considerable technological capabilities in this field. Automatic data handling equipment may be used in some critical areas although we consider it unlikely that the USSR will have an integrated country-wide system in operation by 1960.

120. *Antiaircraft Artillery.* The Soviets apparently still plan to place considerable reliance on AA artillery. We estimate that the following new weapons will become available through 1960:

Weapon	Available	Max. Vertical Range Ft.	Effect. Ceiling Ft.	Muzzle Velocity Ft. Sec.	Rate of Fire RPM
Multi-barrelled 30 mm	1956	18,000	5,000	3,500	500–600 per barrel
Unguided High-Level Rocket (Zenith)	1955–1957	over 60,000	50,000 to 60,000	4,000 burn-out velocity	50–60 per sec per vehicle
Unguided Low-Level Rocket	May appear by 1960				

Estimated deployment of AA guns through 1960 is as follows:

(See table on page 26)

121. *Guided Missiles.* It is highly likely that the USSR will place increasing reliance on guided missiles for air defense use.[12] During 1957-1958, we estimate that series production could begin on a surface-to-air missile with terminal homing, a maximum effective range of 50,000 yards at 60,000 feet altitude and a warhead on the order of 500 pounds. The low-yield nuclear warhead probably available for this missile in 1958 would greatly increase the kill probability as well as the problems of attack. Sometime after 1960 the Soviets could have a further improved surface-to-air missile with terminal homing equipment, a low-yield nuclear warhead, and a maximum effective range on the order of 100 nautical miles.

122. Air-to-air guided missiles may become operational as fighter armament during the period of this estimate. Although there is no evidence of a Soviet air-to-air missile program, it is estimated that the USSR now has the capability to produce a missile with the following characteristics: range in the order of 5,000 yards varying with release altitude, supersonic, infrared homing, weight 175 pounds, and a 25–30 pound warhead. Such a missile would be limited to tail cone attacks under generally fair weather conditions at the attack altitude. The FRESCO could be modified to carry four such missiles with infrared homing and be operational now. During the period 1955-1958, the range of this missile could be increased to approximately 10,000 yards and might not be limited to tail cone attacks. By 1958-1960 a completely new air-to-air missile with a semiactive terminal homing system, a warhead of about 50 pounds and an effective range of approximately 10,000 yards varying with release altitude could be ready for series production. If this missile does not appear until the latter part of the 1958-1960 period, an active homing head could be incorporated.

[12] See NIE 11-6-54 "Soviet Capabilities and Probable Programs in the Guided Missile Field," dated 6 October 1954 for a detailed estimate.

ESTIMATED DEPLOYMENT OF OPERATIONAL SOVIET BLOC AAA,
MID-1955-MID-1960

	1955		1956		1957		1958		1959		1960	
	Heavy	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy	Light
European Satellites	1,700	1,600	1,850	1,750	2,000	1,900	2,150	2,150	2,300	2,300	2,500	2,500
Soviet Establishments in Europe	550	1,550	800	2,300	800	2,300	800	2,300	800	2,300	800	2,300
Soviet Western Frontier	1,850	2,550	2,400	3,750	2,400	3,750	2,400	3,750	2,400	3,750	2,400	3,750
Soviet Northwest	300	350	350	450	350	450	350	450	350	450	350	450
Moscow and Approaches	1,150	700	1,450	1,100	1,450	1,100	1,450	1,100	1,450	1,100	1,450	1,100
South Central Frontier	700	600	850	900	850	900	850	900	850	900	850	900
Ural Area	200	450	350	800	350	800	350	800	350	800	350	800
Siberia and Baikal Area	300	300	400	450	400	450	400	450	400	450	400	450
Soviet Far East	900	1,400	1,250	2,000	1,250	2,000	1,250	2,000	1,250	2,000	1,250	2,000
Communist China North Korean-Viet Minh	1,950	2,350	2,100	2,500	2,200	2,500	2,300	2,500	2,400	2,500	2,500	2,500
TOTAL	9,600	11,850	11,800	16,000	12,050	16,150	12,300	16,400	12,550	16,550	12,850	16,750

NOTES: Heavy-includes 85mm, 100mm, and 122mm AA guns
Light-37mm and 57mm automatic AA guns

123. *Probable Future Guided Missiles for Air Defense.* Characteristics of Soviet missiles that could be available during the period of this estimate are as follows:

Type Missile	Max. Alt. (ft/1,000)	Warhead Weight (lbs)	Missile Weight (lbs)	Range	Guidance
AAGM/1955	[1]	25–30	175	2.5 nm	Infrared
AAGM/1958	[1]	50	300	5 nm	Semiactive radar homing
AAGM/1960	[1]	50	350	8 nm	Active radar homing
SAGM/1955	50	less than 600	...	30,000 to 35,000 yds.	Semihoming head
SAGM/1957	60	500 HE or nuclear	...	50,000 yds.	Terminal homing
SAGM/1960	..	nuclear (1958)	...	100 mi.	Terminal homing

[1] Maximum altitude of the missile is limited by the combat ceiling of the parent aircraft available for use during the period of this estimate.

124. We estimate that the USSR might have more than 200 surface-to-air missile sites in 1960.

125. *Electronic Countermeasures.* Soviet countermeasures capabilities are already high and will probably improve through 1960. We estimate, for example, that by 1960 the USSR can have jamming equipment in operational use for frequency ranges up through 30,000 megacycles.

Economic Impact of Air Defense Program

126. *Cost of Air Defense 1955-1960.* The cost of the air defense program which we have estimated the Sino-Soviet Bloc leaders will probably undertake during this period, has been measured in aggregate terms. While we recognize that money calculations of Soviet production costs and capabilities are only approximations, they do permit the establishment of reasonable magnitudes with which to weigh the economic significance of the program. Such calculations also serve as an indication of the priority and effort which would be required and the possible effects on other military and industrial programs.

127. We estimate that the cost of the estimated air defense program of the Sino-Soviet Bloc will be about 38 billion 1951 rubles for 1955 and about 86 billion 1951 rubles for 1960.

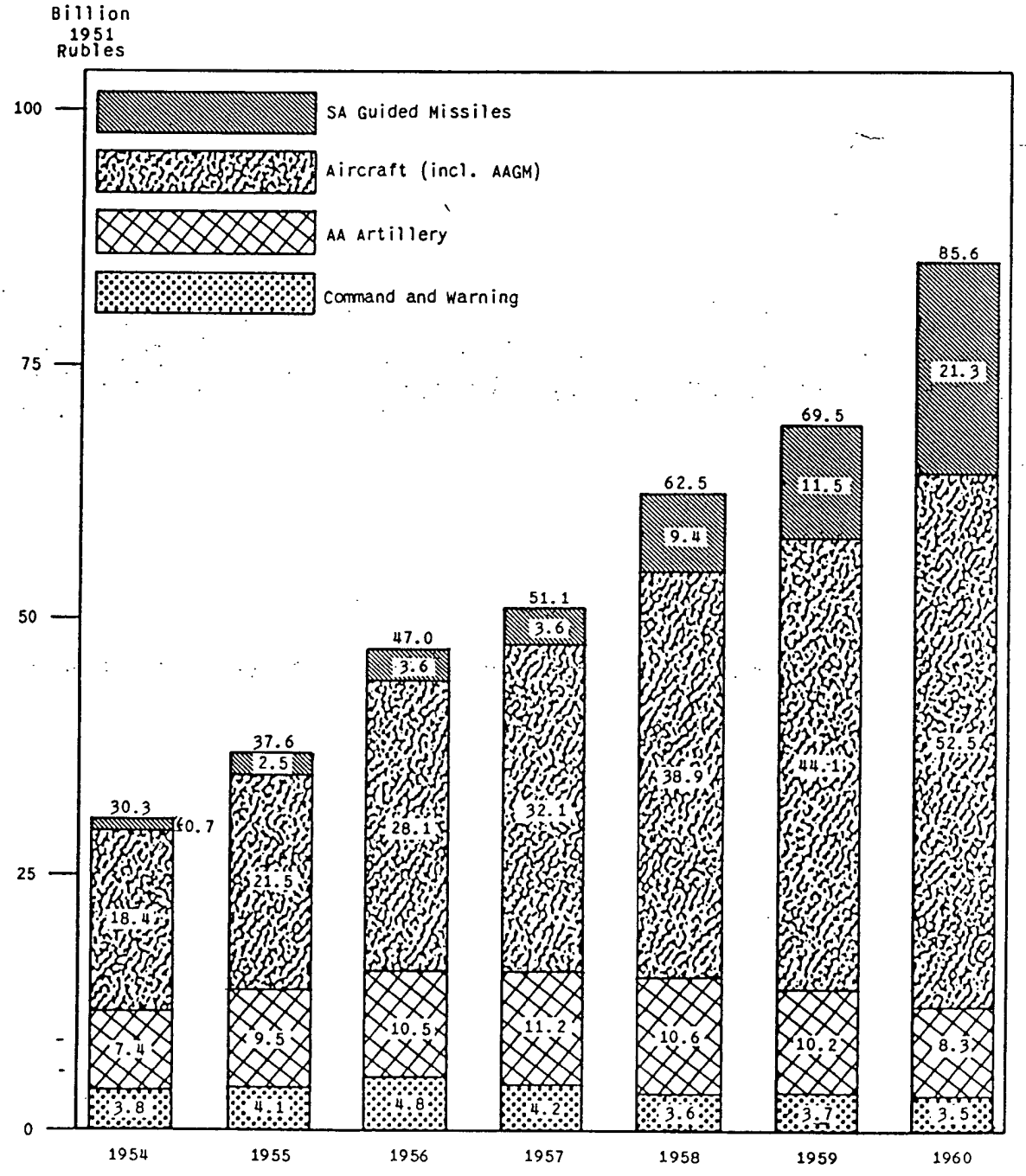
Figure I shows how the total cost of the Sino-Soviet Bloc air defense program is allocated through time and by principal air defense function. Of these totals, approximately 22 billion rubles in 1955 and 53 billion rubles in 1960 would be initial costs while the remainder would be operating costs.

128. The impact of these costs may be illustrated as follows: if total Bloc military expenditures conform to a previous estimate,[13] the cost of this air defense program would rise from about 22 percent of the total in 1955 to about 45 percent in 1960; expenditures for other military programs would have to decline accordingly. If, on the other hand, expenditures for these other military programs did not diminish, but instead rose

[13] Military expenditures by the USSR during the period 1955-1960 were estimated in NIE 11-3-55 "Soviet Capabilities and Probable Soviet Courses of Action through 1960," published 17 May 1955. Since corresponding agreed estimates of the military expenditures of other Bloc countries do not exist, tentative estimates have been made for the purposes of the above paragraph. Even should such tentative estimates be proved to be considerably in error the conclusions arrived at would not be materially altered.

FIGURE I

ESTIMATED SINO-SOVIET BLOC AIR DEFENSE PROGRAM
INITIAL AND OPERATING COST, 1954 TO 1960



at the rate previously estimated for total military expenditures by the USSR alone (a 15 percent increase by 1960 over 1955), the result would be an increase of 40 percent in absolute Bloc military expenditures over the period. (See Figure 2)

129. The burden of the air defense program would not fall equally upon all countries of the Bloc, however. Specialized industrial equipment and trained manpower for the air defense program would have to be provided primarily by the USSR itself, with the assistance of Czechoslovakia, Poland, and perhaps East Germany and Hungary.

130. This air defense program would constitute a substantial but not impossible burden upon the Bloc economy. We believe that the cost would be such as to require either a diversion of resources from other military uses, or an increase in the total military budget such as would probably lead to some reduction in the rate of growth of the economy.

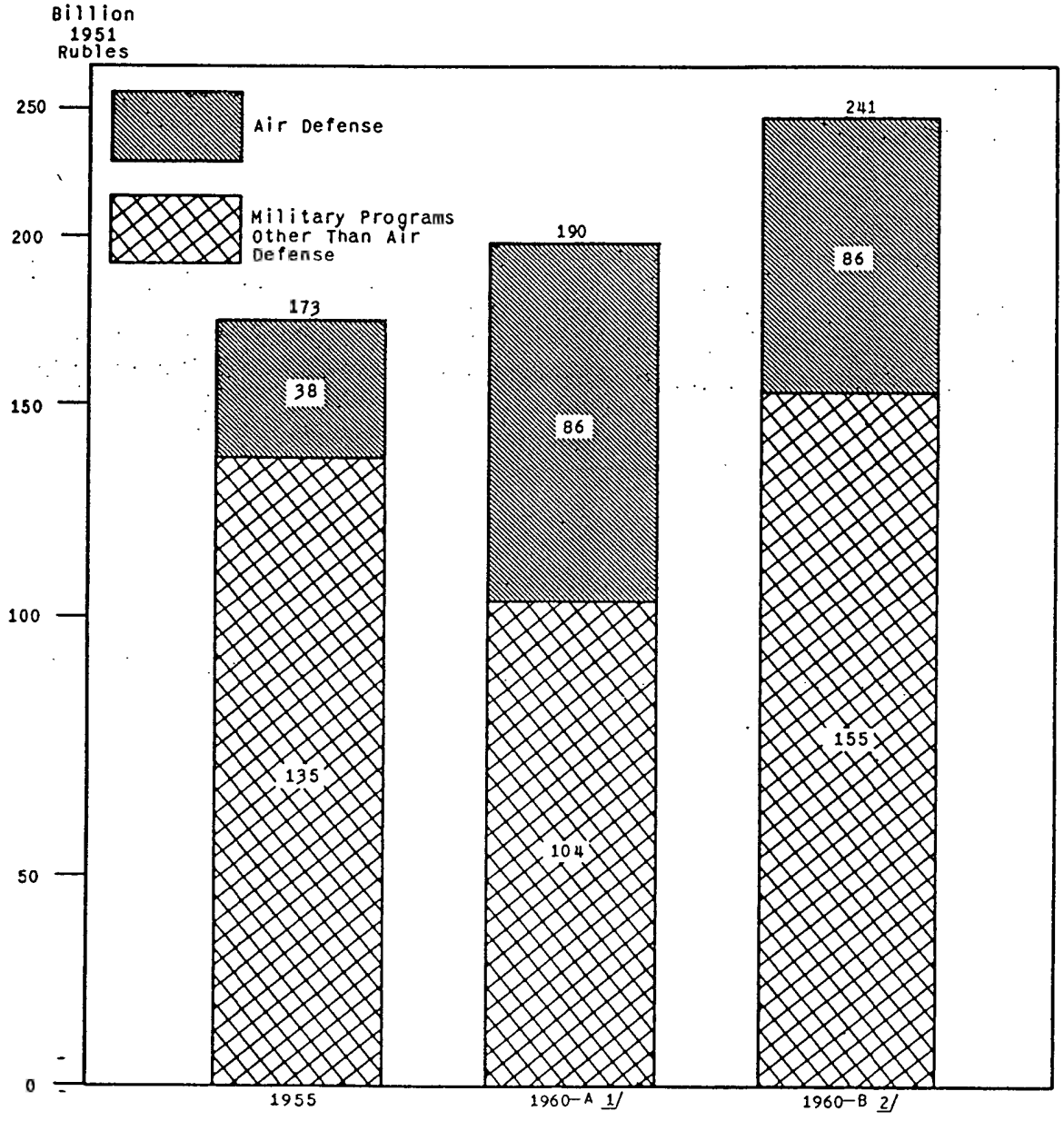
131. *Electronic Equipment and Precision Instruments.* The electronics requirements for the estimated air defense program are very great. Taken together with other military and essential civilian demands they would put a serious strain on the Bloc electronics industry. Estimates of future performance in this industry are necessarily somewhat tenuous. It appears highly likely, however, that the Bloc could not carry out the estimated air defense program without (a) diverting electronics equipment from other military demands or (b) expanding the electronic industry to the limits of feasibility. The latter course would be the more difficult because the rate at which military electronics production facilities could be expanded might be less than the rate applicable to the electronic industry in general. We do not believe that fulfillment of electronics requirements would offer such an obstacle as to make the estimated air defense program impossible; we are certain, however, that it would constitute a very formidable difficulty.

132. A further limitation in the air defense program may well exist in the precision mechanism sector in view of the tolerances involved and the skilled labor required. For example, the estimated number of gyroscopes required for new equipment in 1953 was about 75,000 of which approximately 80 percent were for aircraft use, and few of these gyroscopes were of the degree of precision and miniaturization necessary for use in guided missiles. By comparison the estimated air defense program will continue to demand at least as many gyroscopes for aircraft use and, in addition, estimated air defense missile production would require 4,300 gyros in 1954; 15,000 in 1955; 54,000 in 1957; and 270,000 in 1960.

133. *Other Equipment.* An examination of Soviet Bloc industrial facilities available to fulfill air defense procurement requirements reveals no other apparent restrictions. Although the total poundage of aircraft and engines required to be produced for the estimated program would increase substantially by 1960, these demands are within the capacity of the industry. Similarly, the increase in guided missile production required is probably within the present economic capacity of the Bloc. For other air defense weapons, the production increases required are considerably less than for aircraft and guided missiles and are well within the capacities of the present armament industries. Under current circumstances of supply, basic materials required for the air defense program are apparently not a serious problem to the Bloc. Manpower limitations seem unlikely to place any general restrictions on the program, although some qualitative problems might develop in the precision engineering skills.

FIGURE 2

RELATION BETWEEN SINO-SOVIET BLOC TOTAL MILITARY EXPENDITURES AND ESTIMATED COST OF AIR DEFENSE PROGRAM, 1955-1960



1/ 1960-A - If total military expenditures are held to levels previously estimated. (See footnote to paragraph 125)

2/ 1960-B - If cost of other military programs grows 15 percent from 1955 to 1960 and air defense costs are added.

APPENDIX A

A PROBABLE SOVIET ESTIMATE OF PERFORMANCE CHARACTERISTICS OF US WEAPONS

1955

Bombers	Combat Ceiling (ft)	Speed at Specified Altitude (knots/ft)	Combat Radii (nm)	Bombload or Warhead Wt. (lbs)
B-36	40,000	350/35,000	3,600	10,000
B-47	40,000	450/35,000	1,700	10,000
B-52	47,000	500/40,000	3,000	10,000
B-57	46,000	500/18,000	1,000	5,000
B-66	43,000	500/40,000	1,200	10,000
Fighters				
F-86	45,000	525/35,000	400	500
F-84	40,000	525/35,000	375	3,000
F-100	54,000	750/35,000	375	800
F-101	53,000	900/35,000	800	1,000
Naval Aircraft				
AD	30,000	300/17,500	1,000	3,000
AJ	30,000	400/35,000	750	10,000
A3D	45,000	500/43,000	1,150	8,000
A4D	50,000	500/35,000	800	3,000
F3H	45,000	550/35,000	700	3,000
F4D	54,000	800/35,000	650	3,000
F9F-9	55,000	650/35,000	650	3,000
P2V	low alt.	282/s.l.	1,200	8,000

Guided Missiles		Speed in Mach No.	Range	
Tactical SSGM		3-4	75-100	
Short-Range SSGM	45,000	0.9	500-800	3,000
Air-to Surface	60,000	2.5-3.0	100	5,000

APPENDIX A (Continued)

1957[1]

Bombers	Combat Ceiling (ft)	Speed at Specified Altitude (knots/ft)	Combat Radii (nm)	Bombload or Warhead Wt. (lbs)
Same as 1955				
Fighters				
F-105	55,000	1,100/35,000	700	3,000
Naval Aircraft				
F8U	55,000	750/35,000	650	3,000
Guided Missiles		Speed in Mach No.	Range	
Long-Range SSGM	50,000	0.8–0.9	5,000	6,000
Medium-Range SSGM	60,000	2.4	1,200	3,000

1960[2]

Bombers			Combat Radii (nm)	
B-58	64,000	1,150/60,000	4,000	7,000
Fighters				
Same as for 1957				
Naval Aircraft				
Improved FA	55,000	800/35,000	800	3,000
P6M	35,000	600/s.l.	750	30,000
Improved VP(L)	low alt.	550/s.l.	1,200	16,000
Guided Missiles		Speed in Mach No.	Range	
Long-Range SSGM	85,000	3–4	5,000	7,000
Long-Range SSGM	80,000	3–4	3,000	12,000
Long-Range Ballistic SSGM	200 nm	10–20	5,500	3,000

[1] Only those weapons with higher performance than those for 1955 are shown.
[2] Only those weapons with higher performance characteristics than those for 1957 are shown.

APPENDIX B

ESTIMATED TO&E STRENGTH USSR FIGHTERS 1955–1960

	Mid-1955	Mid-1956	Mid-1957	Mid-1958	Mid-1959	Mid-1960
Fagot	3,800	1,500	.....	.....	.....	.....
Fresco	6,100	7,000	5,900	2,700	300	.....
Farmer	200	1,000	2,200	3,600	4,200	2,900
1957–Day	.....	.....	.....	600	1,800	2,600
1959–Day	.....	.....	.....	.....	.....	600
Total Day	10,100	9,500	8,100	6,900	6,300	6,100
A/W						
1954 A/W (Fresco)	200	400	.....	.....	.....	.....
1955 A/W (Flashlight)	100	600	2,500	3,400	2,900	1,800
1957 A/W	.....	.....	.....	400	1,600	2,500
1959 A/W	.....	.....	.....	.....	.....	500
Total A/W	300	1,000	2,500	3,800	4,500	4,800
Total Fighters	10,400	10,500	10,600	10,700	10,800	10,900

APPENDIX C

PERFORMANCE CHARACTERISTICS OF SINO-SOVIET BLOC EQUIPMENT

AIRCRAFT
1955

	Rate of climb at sea level (ft/min)	Time to altitude (min/ft)	Maximum speed at[1] sea level (kts)	Combat ceiling (ft)	Combat radius without external fuel (nm)	Combat radius with external fuel (nm)
FAGOT (RD-45) (5,000 lb. thrust)	8,300	8.0/40,000	564	49,000	240	380
FAGOT (VK-1) (6,000 lb. thrust)	10,000	6.2/40,000	580	54,000	225	360
FAGOT (VK-1A) (7,000 lb. thrust)	na	6.0/40,000	595	54,000	225	360
FRESCO (without after-burner) (7,000 lb. thrust)	12,200	6.0/40,000	622	56,000	190	na
FRESCO[2] (with after-burner) (7,000 lb. thrust)	25,400	3.7/40,000	634	58,000	na	na
FARMER[3] Twin Jet	33,400	2.7/40,000	645	58,200	325	na
FLASHLIGHT Twin Jet	15,200	5.7/40,000	620	51,000	475	na

[1] At combat weight

[2] Includes use of afterburner for climb and combat

[3] 4.5 min. with external tanks

FUTURE AIRCRAFT[1]

	1957 (New Day)	1959 (New Day)	1957 (New AW)	1959 (New AW)
Time to climb to 40,000 ft. (min)	2.5	2.0	2.5	2.0
Maximum speed–sea level[2] (knots)	670	700	670	700
Maximum speed[2] 40,000 ft. (knots)	700	800	700	800
Maximum speed[2] 35,000 ft. (knots)	750	850	750	850
Combat ceiling (ft)	60,000	62,000	60,000	62,000
Combat radius (nm) (with external fuel)	400	400	400	400
Combat range (nm) (with external fuel)	1,000	1,000	1,000	1,000

[1] It is estimated that these aircraft will be equipped with the armament and fire control equipment shown to the right:

[2] All speds are with thrust augmentation.

Day Fighters 1957

Armament – 50 2"–3" Rockets or
4 30mm guns of 1,000 RPM or
4 air-to-air guided missiles

Fire Control – range only radar with automatic computer

All-Weather Fighters 1957

Armament – 50 2"–3" Rockets or
4 30mm guns of 1,000 RPM or
4 air-to-air guided missiles

Fire Control – AI radar with search range up to 20nm. and lock on range up to 14nm.

Day and All-Weather Fighters 1959

Armament – same as for 1957 day and AW fighters.

Fire Control – AI radar with search range up to 24nm. and lock on range up to 16nm.

ANTIAIRCRAFT ARTILLERY

1955

Estimated Performance of Operational Soviet AA Weapons

Caliber	MV ft/sec	Rate of Fire (RPM)	Proj Wgt (lbs)	Est. eff. Ceiling (ft)
85mm M1939	2,625	15–20	20.2	25,000
85mm M1944	2,950	15–20	20.2	30,000
100mm M1949[1]	3,200	25–30	35.0	35,000
122mm	3,300	10	55.0	40,000–45,000
37mm M1939	2,950	160–180	1.6	4,500
57mm M1950	3,000 3,500	130–150	6.6	15,000
12.7mm MG	2,900	550–600	.10	1,300
14.5mm MG	3,000	500 per barrel	.15	1,500

[1] Proximity fuzes could be employed with weapons of 85 mm or larger.

ESTIMATED CHARACTERISTICS OF ANTIAIRCRAFT ARTILLERY FIRE CONTROL EQUIPMENT

(estimated to appear in 1955)

	Target type		
	P–52	B–47	F–84
Max track range (yds.)	80,000	80,000	50,000
Max search range (yds.)	170,000	170,000	90,000

APPENDIX D

1. The calculation of costs of the air defense program outlined in Section II of this estimate includes all items which can be directly charged to the Bloc air defense program over the period of this estimate. In estimating the cost of this complex air defense program, it was necessary to distinguish between initial costs and operating costs. Initial costs are those that occur only once during the establishment of a program and include such items as base facilities, major equipment, spares for stocks and pipeline, initial training, and transportation. Operating costs are those expenditures which recur regularly, representing the consumption of fuel and maintenance spares, the provision and support of personnel, and the replacement of equipment. However, three types of initial and operating costs were specifically omitted from the calculation. The first type includes costs incurred before 1955, such as drone aircraft and some radar. The second type includes costs incurred in providing facilities and services used for other purposes as well as air defense, such as common-use air bases and the superior command structure. Finally, certain costs of warheads were not included because nuclear warhead costs were not available.

2. In order to reflect changes in weapon systems and the composition and numbers of operating units, cost data were organized and summarized at the smallest practical operational military unit. For scheduling, we have taken the number of units (i.e., missiles, AAA, and aircraft) estimated to be deployed at mid-year as the average number of units operating in the air defense system for that year. It is assumed that the initial costs were incurred the year previous to the first full operating year. Initial costs of the units for each category of major equipment and equipment spares were estimated, giving consideration to the lower costs associated with the volume of production implied in this estimate. It was assumed that trained operating units were the goal of the program. As soon, therefore, as sufficient major equipment became available from production, an operating unit was scheduled for activation and provided with a complete set of special and organizational equipment, initial stocks, and personnel.

3. This activation schedule became the basis of phasing the initial system costs into a time pattern. The cumulative total of the various types of units activated form the basis for working up the operating costs. The operating costs, reflecting the consumption of fuels and spare parts, the maintenance of the establishment and the replacement of major equipment were then applied. During the period of the estimate some primary operating units will be deactivated. In such cases the air defense system is credited for those items that could properly be carried over to a new unit provided with higher performance major equipment.

4. The estimated initial costs of the program from 1954 to 1960 are detailed in Table 1 by sub-categories of programs and similar detail is presented for estimated operating costs in Table 2. It should be noted that the initial costs exceed total operating costs. Because the guided missile program must start from a zero base there is a very large ratio of initial to operating costs in the early years. The ratio of other programs will vary from year to year according to the quantity of initial equipment introduced to the air defense program.

5. In Table 3 the air defense program is recast in terms of the economic sectors upon which the program must impinge for the satisfaction of its requirements. From the standpoint of investment goods the important item in the table is the amount of total industrial procurement which amounts to 21 billion rubles in 1955 and 69 billion rubles in 1960. Put another way, 21 of the currently estimated 78 billion rubles of military industrial goods procurement in 1955 is for the air defense program. Asuming that the current level of hard goods procurement for military

programs other than air defense will not decline in the aggregate over the period of this estimate, military hard goods procurement would have to increase 62 percent from 1955 to 1960 to implement the required air defense program.

TABLE 1

Estimated Sino-Soviet Bloc Air Defense Program
Initial Cost, 1954 to 1960

Billion 1951 Rubles

	1954	1955	1956	1957	1958	1959	1960
Aircraft Program	6.25	6.64	10.67	11.06	14.57	15.73	18.71
Aircraft Armament Program	0.07	0.12	0.21	1.62	2.90	4.40	5.56
Spare Engine Program	1.75	1.91	3.31	4.00	4.57	4.39	5.10
Airfield Augmentation	3.00	4.58	4.58	3.81	3.05	3.05	2.29
Command and Control Program	0.21	0.05	0.03	0.02	0.00	0.00	0.00
Communication System	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Radar Program	1.80	2.00	2.49	1.47	0.74	0.74	0.49
Heavy Gun Program	1.29	2.40	2.40	2.43	1.35	1.35	0.00
Fire Control (Heavy Gun)	0.32	0.41	0.46	0.36	0.36	0.18	0.18
Light Gun Program	0.99	1.15	1.21	1.25	1.19	0.64	0.00
Fire Control (Light Gun)	0.00	0.36	0.72	1.08	1.44	1.53	1.44
SA Guided Missile Program	0.73	2.36	2.90	2.32	7.47	8.52	17.30
TOTAL	16.81	22.38	29.38	29.82	38.04	40.93	51.47

Table 2

Estimated Sino-Soviet Bloc Air Defense Program
Operating Cost, 1954 to 1960

Billion 1951 Rubles

	1954	1955	1956	1957	1958	1959	1960
Aircraft Program	7.13	7.81	8.97	10.95	12.25	13.81	16.20
Aircraft Armament Program	0.11	0.12	0.13	0.16	0.77	1.89	3.63
Spare Engine Program	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Airfield Augmentation	0.00	0.18	0.27	0.55	0.78	0.96	1.14
Command and Control Program	0.78	0.85	0.87	0.88	0.88	0.88	0.88
Communication System	0.02	0.02	0.03	0.03	0.03	0.04	0.04
Radar Program	0.56	0.81	1.06	1.36	1.53	1.62	1.70
Heavy Gun Program	2.27	2.56	2.72	2.84	2.87	2.85	2.74
Fire Control (Heavy Gun)	0.12	0.17	0.23	0.30	0.34	0.38	0.38
Light Gun Program	2.46	2.52	2.69	2.82	2.91	2.88	3.02
Fire Control (Light Gun)	0.00	0.00	0.03	0.09	0.18	0.30	0.43
SA Guided Missile Program	0.00	0.15	0.65	1.26	1.95	2.98	3.95
TOTAL	13.45	15.19	17.65	21.24	24.49	28.59	34.11

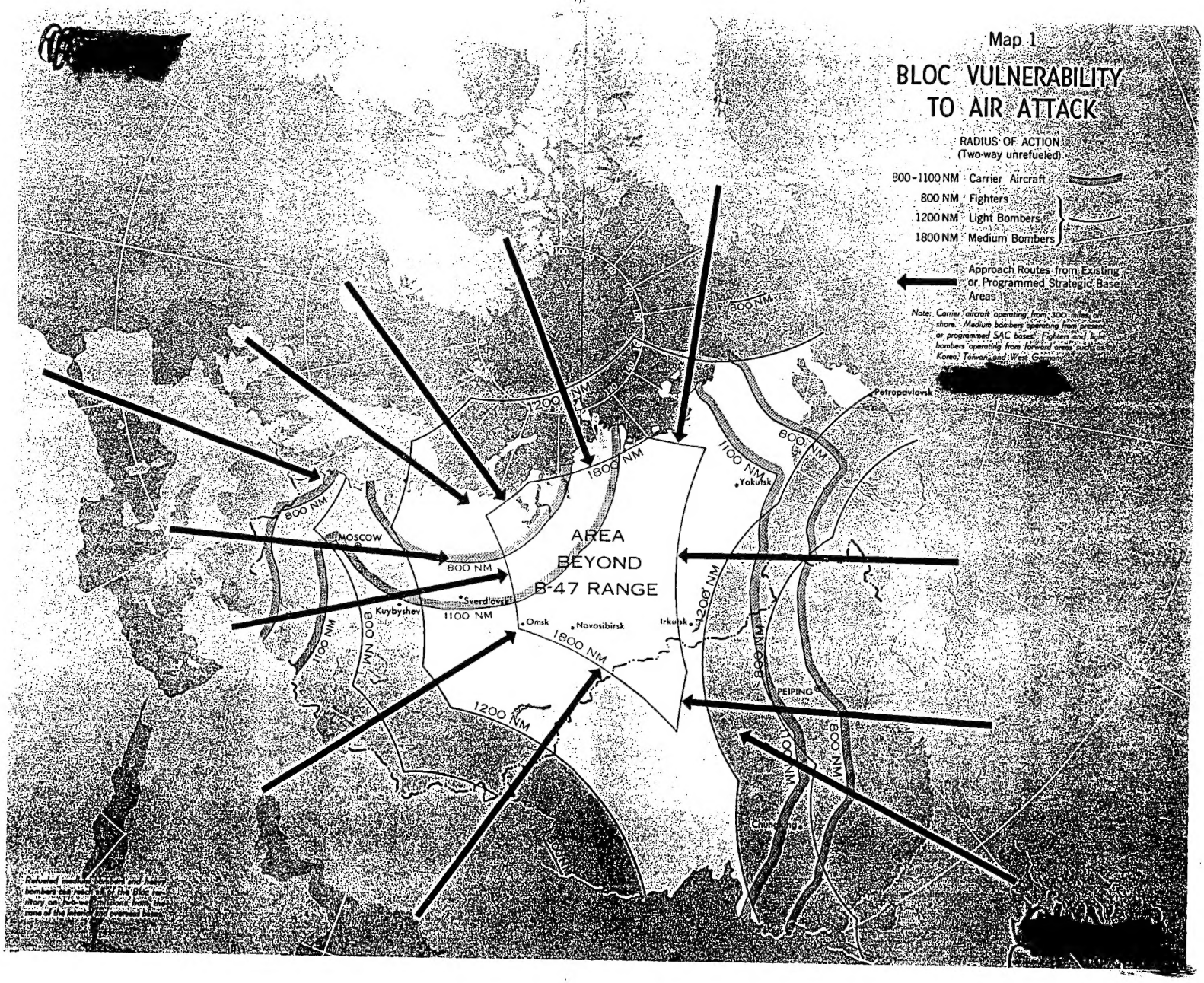
TABLE 3

Estimated Sino-Soviet Bloc Air Defense Procurement
by Sectors of Origin, 1954 to 1960

Billion 1951 Rubles

	1954	1955	1956	1957	1958	1959	1960
Aircraft and Engine Procurement	8.87	9.31	15.42	18.57	23.24	25.75	31.32
Guided Missile Procurement	0.23	0.81	1.15	2.52	6.70	9.78	16.40
Armament Procurement	2.17	3.21	3.43	3.67	3.00	2.76	1.24
Ammunition Procurement	0.31	0.42	0.55	0.63	0.71	0.65	0.58
Special Electronic Procurement[1]	2.49	4.07	5.32	5.38	7.23	8.59	11.93
Fabricated Metals, NEC	1.47	1.80	2.09	1.79	2.96	3.28	5.06
Fuels	1.39	1.33	1.83	2.00	2.28	2.52	2.84
Total Industrial Procurement	16.93	21.25	29.79	34.66	46.12	53.60	69.37
Construction and Construction Material	4.77	6.79	7.02	6.26	5.88	5.90	5.75
Transportation	0.40	0.56	0.67	0.78	1.06	1.22	1.55
Personnel and Services	5.98	6.53	6.83	7.10	7.25	6.70	6.79
Training	2.18	2.44	2.72	2.26	2.22	2.10	2.12
Total	30.26	37.57	47.03	51.06	62.53	69.52	85.58

[1] Electronic procurement such as ground radar, AAA fire control, and ground guidance equipment, which is not included in other procurement categories.


Map 1
BLOC VULNERABILITY TO AIR ATTACK
RADIUS OF ACTION (Two-way unrefueled)
800–1100 NM Carrier Aircraft
800 NM Fighters
1200 NM Light Bombers
1800 NM Medium Bombers
Approach Routes from Existing or Programmed Strategic Base Areas
Note: Carrier aircraft operating from 300 miles off shore. Medium bombers operating from present or programmed SAC bases. Fighters and light bombers operating from forward areas such as Korea, Taiwan and West Germany.
AREA BEYOND B-47 RANGE
MOSCOW
Kuybyshev
Sverdlovsk
Omsk
Novosibirsk
Irkutsk
Yakutsk
Petropavlovsk
PEIPING
800 NM
1100 NM
1200 NM
1800 NM